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SPECIALISED FOOD PRODUCTION

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SPECIALISED FOOD PRODUCTION

CONTENTS

UNIT 1: THE KITCHEN

1.0 INTRODUCTION

We will start our journey into the discipline of Specialized Food Production with the place where it all begins. This unit is about professional kitchen. Professional kitchen is the kitchen at the restaurant or hotel. We will give you a formal definition of the professional kitchen in the beginning of the unit. Professional kitchen are important part of hospitality industry, be it cruise luxury liner, hotels or restaurants. Most restaurants and hotels have uniforms and protective clothing for all the staff. Uniform gives a sense of belonging to the staff and makes it easy to identify them as members of the staff by the clients and guests. We will understand the important concepts about uniforms in this unit.

A professional kitchen has a very well defined hierarchy of kitchen staff. We will learn about it in details. We will try to understand the roles of the various types of chefs and other staff members and what attributes they should possess in order to be able to do their jobs properly. We will also learn about Garbage Disposal Unit.

1.1 UNIT OBJECTIVES

After studying this unit you will be able to

Describe kitchen layouts
Explain classical kitchen brigade
Describe the functions of the various chefs
Describe what attributes the various chefs should possess to meet the professional needs
Explain how kitchen coordinates with the other staffs in hotel.
Elaborate on functioning of Garbage Disposal Unit.

1.2 KITCHEN LAYOUT

The following are the main sections of a kitchen

Preparatory section
Main cooking area
Continental section
Bakery and confectionery
Indian section
Butchery

1.2.1 Preparatory Kitchen
The preparatory kitchen performs the following task

Checks incoming supplies of fresh vegetables after ensuring that the walk has been cleaned properly before stacking the new supplies
The racks should be clean properly removing the decayed material before arranging the fresh material
Checks all the requisition send by the main kitchen and other kitchen, makes the requisition ready and sends the same to the kitchen for mise en place.
Pre preparation of vegetable is been made as per the requirement of the various kitchen day to day working
Ensures that the extra vegetables are packed and stored in the walk in cooler
Prepares various pastes and masalas for Indian Food
Portion packs in bags and tags the various cuts of vegetables

1.2.2 Main Cooking Area

CONTINENTAL SECTION

The continental section of the main kitchen is divided into three sub section

Soup

Roast and sauce

Vegetables

Soup Section

In this section the following work is performed by the chef
Prepares stocks for the soups(fish ,meat, chicken)
Prepares basic soups such as consommé, puree, broth.
Prepares speciality soups such as bisque, French onion soup, Shorba, Yakni, and soups on the menu.
Preparation of all garnishes is as done here.
Roast and Sauce Section
The roast and sauce section performs the following work
Prepares basic sauces such as demi-glace, béchamel, veloute, tomato sauce etc., and their derivatives.
To cook meat, poultry and game as required such as grilling, roasting, stewing, and frying.
To prepare all fishes and shellfishes such as frying, grilling, baking, etc.

Vegetable sections
The vegetable section performs the following function
Prepares all kinds of vegetables and sauce
Prepares all types of pasta, rice, noodles etc and their sauces
Prepares all the vegetarian delicacies and specialty on the menu

BAKERY AND CONFECTIONERY

The bakery and confectionery performs the following functions

Prepares dough for various breads and rolls
Bakes various bread and rolls
Bakes all sweet yeast dough products such as Danish pastry, croissant ,doughnut ,brioche
Prepares sponge for cakes and gateaux
Prepares various icings and frostings
Prepares and decorate the cakes
Prepares pastries
Prepares various paste such as puff pastry, shortcrust, choux.
Prepares various puddings and desserts.
Prepares special ice creams and ice cream cakes
Prepares petit fours, cookies, mints and chocolates.
Prepares decorative centre pieces such as pulled sugar baskets, gum paste.

INDIAN SECTION

The Indian section is sub divided in three sections

1.Curry section

To prepare various meat and chicken preparation
To prepare cottage cheese and vegetable curries.
To prepare lentils
To prepare all types of rice preparation

2.Tandoor Section

To prepare the marinades
To prepare and make kababs
To prepare dough for various Indian breads
To bake the breads

3.Halwai section

To prepare all types of Indian desserts
To prepare all kind of snacks Indian
To prepare all types of accompaniments

MEAT PROCESSING SECTION

The meat processing as performs the following functions

Checks all in received meat and fish for quality , weight, freshness from the vendor
Checks for proper storing of the items and hygiene and sanitation of the area
Checks all the requisitions and delivers the same to the various kitchen for the working of the day.
Checks all requisition made by the main kitchen and other kitchen for the following days and get the required material accordingly from the stores.
Prepares the *Mise en place* required for the banquets, a la carte, and par stock.
Portioning, packing, tagging and stacking the various cuts.

Check your progress

What are the broad categories of sections in a professional kitchen?

What are the sections in Indian Section?

What are purposes that Preparatory Kitchen is expected to serve?

1.03 WORKING SPACE

Now that we have been introduced with the various types of equipments, let us see how we can arrange them for best utilization of space, time, energy and efficiency of the staff. We will see features of our working environment.

LOCATION OF THE KITCHEN

The kitchen should be located near the food outlet but if there is space constraint then the kitchen should be as near as possible to the food outlet. The factors which need to be considered while planning a kitchen is given below.

Liquor perishable and other food items should be stored as close to the kitchen as possible.

The service personnel should be able to get in and out of the kitchen without disturbing the operations. There should be no passage going through the kitchen. The local law must be followed.

WORKPLACE DESIGN

To achieve maximum productivity and efficiency a well-designed work place is required. The following factors should be considered while designing the work place:

- There should be floor space for the workers to move. There should be space for equipment, work tables and counters.
- There should be space for storing new materials on tables, carts, trolleys, trays.
- There should be space for storing finished product. Equipments such as bainmarie, hot case, salad trolleys, desert trolleys.
- There should be space for storing ingredients such as spices, dressing, sauces, seasoning.
- There should be space for utensils such as knives, choppers, slicers, beaters.
- There should be enough space for cold storage facilities.

FLOOR SPACE

The space required for a single person to work is 24-36 inches. If there are equipment's such as oven, steamers, refrigerators in the work area, the area should be extended by 6-12 inches. If two workers are working back to back the minimum work area required should be 48 inches.

WORK SURFACE SPACE

Work surface space depends on the work performed and the task conducted. Most tasks can be performed on a surface which is two feet in width and four feet in length Task such as chopping, cutting, slicing, whisking usually need a height of 30-31 inches.

MATERIAL HAND EQUIPMENT AND UTENSILE STORAGE

The space over and under the shelves, bins, drawers and cabinets are generally used for storage purpose. The placement of this equipment ensures smoother and easier working. The mobile trolleys should be placed near to the work place.

WORKPLACE ENVIRONMENT

It is necessary to have a encouraging work environment to increase the efficiency of the workers with minimum efforts. Continuous expose to high temperature, high humidity and radiation may result in considerable discomfort. The kitchen workers can perform efficiently if the temperature is between 65-70 degree F in summers and 69-73 degree F in winters. The temperature and weather of the work place can be controlled by managing and heating, cooling and ventilation of the buildings. The heat and moisture can be minimized by using products which are well insulin. All pipes carrying hot water should also be insulated.

The lighting system should provide sufficient light for the workers to handle equipment and

Ingredient properly and work conveniently. Care should be taken to avoid direct and reflected.

Light as it obstructs visibility. A good exhaust and ventilation system is required to remove smoke, odour, moisture and heat. In warmer climate air conditioning is required.

Equipment Placement

The layout of a kitchen is conceptualized after developing the work place, determining the equipment required and estimating the total space. The layout is determined by the flow of material, pre-preparation and pickup. The layout must minimize the movement which will conserve energy and prevent fatigue.

PRINCIPLES FOR PLANNING THE LAYOUT

- By passing crossing of personnel should be minimized.
- The flow should be along straight lines; too many turns will obstruct the operation.
- Reverse movement of personnel should be minimized to prevent accidents.

- All plumbing service equipment’s should be installed close to each other.
- The central panel of electricity should be installed in the same general area where the electrical equipment is to be used.
- Hot food area should be planned in one place and cold food area in another.
- The distance between the hot range and the pickup counter should be at least forty two inches.
- The fryer should never be planned near the sink.
- An electrical appliance and gas appliance should be kept at a distance of at least eighteen inches.
- The equipment should be arranged in such a manner that it minimizes walking.
- A small sink near the cooking area is a must.
- A refrigerator near the cooking area is required to reduce the opening and closing of the walk in refrigerator.
- There should be to separate doors for the service personnel to leave and enter the kitchen.
- Area such as pot wash, masala grinding should be planned away from the restaurant.
- An effective exhaust system should be installed to prevent over heating in the kitchen.
- Equipment’s such as soup trolleys, bread warmers, tea coffee boilers, ice cream cabinet should be kept near the restaurant to prevent disturbance in the food production area.
- Storage area for china glass wear linen should be provided with ample space.
- Sufficient area should be allocated for pot wash.

Positioning ranges or cookers is important. One efficient way is to install stove equipment in a cluster, with a ventilation canopy above. There should be room for a cook at the centre of this work 'island' and plenty of space around it. Bain made and stockpot stands should be close to ranges. Boiling tables, steaming ovens and vegetable boiling pans should also be near the centre of the kitchen and should be easily accessible to the workers at vegetable preparation tables. Adequate provision for carts, mobile racks and other mobile processing apparatus should he made. The deep fat fryer should be sited near the main ranges, but with a separate extract canopy of its own. Generally, a canopy edge should project beyond a cooking equipment by at least 45 mm (18 in) on the side where equipment doors open and 305 mm (12 in) on the other sides. It should be mounted 2 m (6 ft 9 in) above floor level. Canopies should be fitted with a small gutter around the bottom to deal with any

Food Preparation Surfaces

Preparation tables topped with stainless steel, laminated plastic or some other impervious materials are easy to clean, and thus, hygienic. Human beings vary in size and reach, yet tables and work surfaces must he sufficiently high for everyone. Short employees can always use a stand, but taller employees should not be forced to bend. The best solution is an adjustable table with screw-out legs. Failing that, the table heights, which will suit most people, are as follows:

For light work, average worktable heights are 925 to 975 mm (37 to 39 in) for women and 975 to 1,000 mm (39 to 41 in) for men; for heavy work, height approximately 900 mm (36 in) is good. People can reach approximately 370 to 500 mm (14 1/2 to 21 in) without stretching.

A worktable's width should be 700 to 750 mm (24 to 30 in). If the table has to accommodate containers or other material at the back, then a 900 mm (36 in) width is sufficient. Approximately 1.2 to 1.8 meters (4 to 6 feet of table length is adequate for one person), and 2.4 to 3 m (8 to 10 ft) suffices for two people working side by side. These figures are all average estimates and should not be considered definitive.

Fig 1.00: Work Table

Cutting Boards

Chefs have long preferred wooden cutting boards, but it is now known that these are more contaminated than impervious surfaces having no cracks or pores to collect food particles and bacteria. Washing wooden boards at temperature at less than 42° C (108° F) does not kill the bacteria. As a result, butcher's blocks and cutting boards now have synthetic surfaces made of polypropylene, rubber clay compound, synthetic rubber or some other impervious material. Chefs must select boards according to costs, operational requirements and their own personal experience.

Fig 1.00: Chopping Board

Sinks

Ancillary tasks are also important. Arrangements for washing of pans, crockery and cutlery must be convenient as well as sanitary. There should be adequate racking for washed dishes and space for those awaiting treatment. Mechanized systems with conveyer belts should be used if affordable. Sinks and draining both should be fitted wherever possible along the external walls. More natural light will be available to people working at them if they are placed under windows. The guidelines mentioned previously for workable heights and width should also be applied to sinks. Detachable tops for sinks may be useful (especially in vegetable room) in providing extra preparation space. In addition to stainless steel sinks for dishwashing, porcelain sinks should be available for ordinary hand washing .

Fig 1.00: KITCHEN Sink

Ventilation

The efficiency and productivity of the kitchen staff may be hampered or enhanced by the kitchen's levels of heating and ventilation. Kitchen ventilation must be sufficient to maintain comfortable working conditions, prevent condensation and confine cooking smells to the kitchen. A kitchen will be clean and grease-free only if the ventilation system is proper. Proper kitchen ventilation system improves indoor air quality as it removes harmful cooking contaminants (e.g., smoke, heat, steam, odour and hazardous gases such as nitrogen dioxide and carbon monoxide generated by gas stoves).

The three basic factors should be considered for choosing a kitchen ventilation system:

Price
Noise
Effectiveness/capacity

Colour

The colour of walls, ceilings and floors can aid staff efficiency and cleanliness, by increasing light reflection, and can affect staff moods, by providing an encouraging and pleasant workplace. Advice should be sought from an architect, interior designer or other expert regarding the reflective value and the most effective use of colours. Different paint manufacturers often use different descriptive names

for the same basic shades of colour. Preferable shades of colour for a well-planned kitchen are white, off-white, ivory, buttermilk, pale-yellow, pale-green, pale-blue, bluish-green. The colour is also important in creating effects of spaciousness or closeness. The cool colours (blue, green, ivory), for instance, make an area seem larger and airier. Hot colours (red, orange, yellow), on the other hand, make space seem smaller. Careful use of colour gives the decorator an opportunity to 'modify' faults that cannot be structurally altered.

Ceilings

On kitchen ceilings, paints that inhibit moisture condensation should be used. Ceilings need no longer be very high to accomplish ventilation purposes because fan and air conditioners are common. Nevertheless a high ceiling up to approximately 3 in (10 ft) can give workers a psychological lift and also aid in lighting. A hemmed-in oppressive room is to be avoided. On the other hand, higher ceiling kitchens are noisier kitchens unless sound-deadening materials are used.

Storage Temperature

Storage temperature (without refrigeration) recommended for dry goods and vegetable storage are approximately 5°C to 21°C (41°F to 70°F) for 8°C to 20°C (64°F to 75° F) for ripening fruits 10 (50°F) or potatoes and 9°C (48°F) for other vegetables These temperature should be maintained by natural ventilation or by air conditioning in warm weather.

Vegetable Storage

Vegetables should be stored and prepared in an area separate from the kitchen that soil brought in with them does not come into contact with other foods. Vegetables packed close together in warm, unventilated corners will deteriorate rapidly. They will last much longer if stored on raised platforms with slats or open mesh racks so that they are kept as cool and as exposed to circulating air possible. Galvanized tubing is preferable to wooden shelves. Racks or bins should be mounted at least 230 mm (9 in) above the floor and fitted at the bottom s removable dust collection trays. An electrically operated peeling machine, a tank, a sink, and preparation tables should be included in the adjacent vegetable section.

WORK CENTERS IN THE KITCHEN LAYOUT

Work centres in the kitchen layout should be planned on the following basic concepts:

- SMOOTH WORK FLOW
- PREVENTION OF CONGESTION AT WORK TABLES AND SINKS
- PROVISION OF A COMFORTABLE WORK ENVIRONMENT
- HYGIENE AND SANITATION

SMOOTH WORK FLOW:

Smooth work flow in kitchen can be managed by arranging the work performed in a organized manner. The following are the main work centres:

- Preparation centre for meat fish and poultry.
- Preparation centre for vegetables and fruits.
- Cooking centre.
- Service centre.
- And washing up area.

PREVENTION OF CONGESTION AT WORK TABLES AND SINKS:

Overcrowding of kitchen is possible due to:

- Improper planning and placement of large equipment's may create unnecessary congestion. 3.5-4 sq meter floor space per person is required.
- Improper work schedule and timing. The job distributed among the members is carried on smoothly without causing inconvenience to one another.
- The equipment's should be used in a systematic manner, over utilization of equipment's may result in congestion.
- The entry of non-staff members of kitchen should be restricted to avoid overcrowding in the kitchen which will restrict smooth flow of work.

PROVISION OF A COMFORTABLE WORK ENVIRONMENT:

- The kitchen produces a lot of heat due to equipment's used in the kitchen. It is very difficult to control the temperature and humidity. Extractor hoods are installed over the cooking area trying to control the heat and temperature.
- The floor should be noise resistant and non-slippery. The sealing and walls should be noise proof. The kitchen should be spacious, bright, having a relax working environment.
- The workers will be more efficient if they work and feel safe in the kitchen.
- The working environment of the kitchen should not be tensed but a harmonious relationship must be maintained at work place. Co-ordination between the seniors and there juniors should be there to provide a healthy work environment.

1.04 CLASSICAL KITCHEN BRIGADE

The workforce which works in the kitchen is called as KITCHEN BRIGADE. The chefs and his team play an important role in the working of the kitchen smoothly. The Executive chef is the head of the kitchen followed by other chefs. Each chef is specialized in his section and work.

Executive Chef → Sous Chef →

- Sauce Cook
- Roast Cook
- Fish Cook
- Grill Cook
- Vegetable Cook
- Soup Cook
- Larder →
  - →Cold Work
  - →Hors d'oeuvre
  - →Butcher
- Pastry Cook →
  - →Baker
  - →Ice Cream
- Indian Section→
  - →Tandoori
  - →Halwai
- Relief Cook
- Breakfast Cook
- Staff Cook
- Commis, Porter, Apprentices

1.04 DUTIES AND RESPONSIBILITIES OF VARIOUS CHEFS IN KITCHEN

EXECUTIVE CHEF: *The executive chef performs the following responsibility.*

Works with the policies, standards and service procedure of the department.

Responsible for maintenance and handling of equipments.

Estimates the needs of the guest and attends to them quickly.

Acquaints himself with all aspects, services and activities of the hotel to attend to the guest enquires.

Readdresses the grievances of the guest.

Observes the guest reaction and consults with the service staff.

Monitors and ensures cleanliness and sanitation in all kitchen areas.

Examines the routine operational activities; catering activity; forecast; purchases; house count; meetings; VIP's; appointments.

Responsible for regulating operational duties and asings tasks to staff members.

Communicates with the sous chef to incorporate changes in schedule.

Inspects daily physical inventory of specified food item.

Ensures that recipe cards, production schedules, platting guides and photographs are recent.

Monitors the performance of staff members.

Ensures that staff members maintain personal hygiene and abide the sanitation and health regulation.

Identifies the situation that tend to compromise the standard of the department
Communicates needs with purchasing and storeroom personnel and ensures that only quality products are received.
Ensures that each kitchen work area is stocked with adequate tools , supplies and equipments for the business
Responsible for ensuring that the staff prepares menu items
Maintains proper storage procedures, specified by the authority
Develops new menu items
Reviews the sales and food costs on a daily basis
Conducts annual performance appraisals of staff members
Conducts interviews and employs new personnel as per the standards of the hotel
CHEF DE CUISINE
The chef is responsible for the kitchen.
He acts as a cook and also looks after the administration.
He should be efficient ad capable of maintaining discipline.
He must be aware of the prices, commodities in seasons.
He organizes and supervises the work of the kitchen
He hires, trains and manages his staff

The chef is responsible for the staffing of the kitchen and for the organization of duty rosters.
The quality and presentation of food is one of the major concerns of the chef.

SOUS CHEF

He is assistant of the executive chef and second in command
He heads the operation of the kitchen
He assists the chef de cuisine in all his duties.
He is responsible for the functioning of the kitchen and also monitors the activities.
The sous chef prepares the duty roaster
He also prepares an order for food products to be purchased, for day to day requirement.

CHEF DE PARTIE

Chef de partie heads a particular section of the kitchen and is responsible for managing his section of the kitchen.
Chef de partie is assisted by a commis, cook and trainees in the kitchen
In long working hours, the working period is split between the chef the partie and the first commis.

CHEF SAUCIER

The position of chef saucier is the highest amongst the station cooks
He is regarded as an important cook as he carries out the complex task of preparing sauce for meat, poultry and entrees.
He prepares these sauces keeping in mind that the sauces are distinctive in taste bt not overpowering.

CHEF ROTISSEUR (ROAST COOK)

The chef rotisseur supervises that section of the kitchen in which roasting and grilling is carried out.
He is responsible for preparing braised roasts and grills of meat and poultry and the accompanying sauces and garnishes.

CHEF POISSONER (FISH COOK)

The fish cook is responsible for preparing all the fish entrees.
He gets the raw fish in required quantities and cooks, garnishes and sauces the fish dishes.
The repertoire of fish dishes, their cooking method and handling is an art and extensive training and judgement are required from the chef

CHEF POTAGE

The soup cook is responsible for preparing all types of soups and the accompanying garnishes.

CHEF GARDE MANGER (LARDER COOK)

The larder cook holds a important position in an establishment

He prepares the food that is processed for the main kitchen
He also supplies food item to the cold buffet which is a storehouse for items such as fruits, salad.
He carries out a number of responsibilities as he supervises various subsections such as salad section, hors d oeuvre and the butchery

CHEF ENTREMETTIER (VEGETABLE COOK)

The vegetable cook prepares all the vegetable dishes.
He is responsible for preparing all the vegetable accompaniments which are served with other main course

CHEF PATISSIEUR(PASTRY COOK)

The pastry cook is responsible for making pastries, breads, cakes and other baked products
He also ensures the regular supply of raw material for the production of pastries
He is responsible for serving the dishes in a unique and decorative manner.

CHEF DE BANQUET(BANQUET COOK)

The brigade comprises of a banquet chef and chef de parties who are
Assisted by commis
The banquet chef coordinates with the chef de parties on the number of dishes supplied to the service point
He makes arrangement for the point
The completion of semi-finished
dishes at the service
The banquet chef works in collaboration with the banqueting manager and deals with issues pertaining to the service and special dishes required

CHEF TOURANT (RELIEF COOK)

The chef tourant relieves other chefs or cook in the work area.
He does not carry out any specific responsibilities but plays the role of a substitute chef
He should be capable of running all station of the kitchen
He is skilled and has knowledge of all the stations of the kitchen.

CHEF DE PETIT DE JEUNER (BREAKFAST CHEF)

The breakfast cook starts his work early in the morning as he is responsible for the complete breakfast service.
He must be a skilled in his work
He makes arrangement for the meals served in the breakfast
He also helps the soup and the vegetable cook in their work

CHEF COMMUNAR (STAFF COOK)

The food for the staff is prepared by a number of chefs de partie, of large hotel, this is the responsibility of a separate section.

The section comprises of the staff cooks who cook food for the lower and supervisory staff.

KITCHEN PORTERS

The kitchen responsible for managing the issue and collection of laundry from the kitchen personnel.
The kitchen stewarding department looks after the pots and pans, which are no longer a apart of the kitchen in large establishments

COMMIS

A commis is an apprentice in kitchen who works under a chef de partie to learn the station responsibilities and operation.
This may be a chef who has recently completed formal culinary training or is still undergoing training
The designation of a commis varies from commis I, II, III.

Check your progress

What is the hierarchy of various chefs working in a kitchen?

Draw a diagram showing the line of command for the various chefs working in a professional kitchen?

What are the responsibilities of the Executive Chef?

1.06 GARBAGE DISPOSAL UNIT

A garbage disposal unit (also known as a garbage disposal, waste disposal unit, garbage disposer, or in Canadian English a garburator) is a device, usually electrically powered, installed under a kitchen sink between the sink's drain and the trap. The disposal unit shreds food waste into pieces small enough—generally less than 2 mm (0.079 in)—to pass through plumbing.

Garbage disposal units are used extensively in United States households, but are far less common elsewhere.

he garbage disposal was invented in 1927 by John W. Hammes, an architect working in Racine, Wisconsin. He applied for a patent in 1933 that was issued in 1935. His InSinkErator company put his disposer on the market in 1940.

Hammes' claim is disputed, as General Electric introduced a garbage disposal unit in 1935, known as the **Disposall**.

In many cities in the United States in the 1930s and the 1940s, the municipal sewage system had regulations prohibiting placing food waste (garbage) into the system. InSinkErator spent

considerable effort, and was highly successful in convincing many localities to rescind these prohibitions.

Many localities in the United States prohibited the use of disposers. For many years, garbage disposals were illegal in New York City because of a perceived threat of damage to the city's sewer system. After a 21-month study with the NYC Department of Environmental Protection, the ban was rescinded in 1997 by local law 1997/071, which amended section 24-518.1, NYC Administrative Code.

In 2008, the city of Raleigh, North Carolina attempted a ban on the replacement and installation of garbage disposals, which also extended to outlying towns sharing the city's municipal sewage system, but rescinded the ban one month later.

Adoption

In the United States, some 50% of homes had disposal units as of 2009, compared with only 6% in the United Kingdom and 3% in Canada.

In Sweden, some municipalities encourage the installation of disposers so as to increase the production of biogas. Some local authorities in Britain subsidize the purchase of garbage disposal units in order to reduce the amount of waste going to landfill.

Rationale

Food scraps range from 10% to 20% of household waste, and are a problematic component of municipal waste, creating public health, sanitation and environmental problems at each step, beginning with internal storage and followed by truck-based collection. Burned in waste-to-energy facilities, the high water-content of food scraps means that their heating and burning consumes more energy than it generates; buried in landfills, food scraps decompose and generate methane gas; a greenhouse gas which contributes to climate change.

The premise behind the proper use of a disposal is to effectively regard food scraps as liquid (averaging 70% water, like human waste), and use existing infrastructure (underground sewers and wastewater treatment plants) for its management. Modern wastewater plants are effective at processing organic solids into fertilizer products (known as biosolids), with advanced facilities also capturing methane for energy production.

Operation

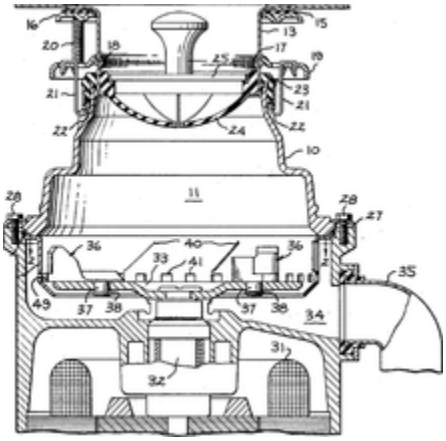

Fig 1.00The parts of a garbage disposal

A high-torque, insulated electric motor, usually rated at 250–750 W (⅓ to 1 horsepower) for a domestic unit, spins a circular turntable mounted horizontally above it. Induction motors rotate at 1,400–1,800 rpm and have a range of starting torques, depending on the method of starting used. The added weight and size of induction motors may be of concern, depending on the available installation space and construction of the sink bowl. Universal motors rotate at higher speeds (about 2,800 rpm), have high starting torque, and are usually lighter, but are noisier than induction motors, partially due to the higher speeds and partially because the commutator brushes rub on the slotted commutator. Contaminated water leaking on to the commutator can lead to major damage, which is why most garbage disposals today use induction motors. The higher starting torque of those appliances with a permanent magnet motor ensures in most cases that there will be no blockage.

Inside the grinding chamber there is a rotating metal turntable onto which the food waste drops. Two swiveling metal impellers mounted on top of the plate near the edge then fling the food waste against the grind ring repeatedly. Grooves in the grind ring break down the waste until it is small enough to pass through openings in the ring, whereupon it is flushed down the drain.

Usually, there is a partial rubber closure on the top of the disposal unit to prevent food waste from flying back up out of the grinding chamber. It may also be used to attenuate noise from the grinding chamber for quieter operation.

There are two main types of garbage disposals — continuous feed and batch feed. Continuous feed models are used by feeding in waste after being started and are more common. Batch feed units are used by placing waste inside the unit before being started. These types of units are started by placing a specially designed cover over the opening and twisting it to allow magnets in the cover to align with magnets in the unit. Because it is covered during operation, it is quieter than continuous feed models. Small slits in the cover allow water to flow through. Batch feed models are also safer, since the top of the disposal is covered during operation, preventing foreign objects from falling in.

Waste disposal units may jam, but can usually be cleared either by forcing the turntable round from above or by turning the motor using a hex-key wrench inserted into the motor shaft from below. Especially hard objects accidentally or deliberately introduced, such as metal cutlery, can damage the waste disposal unit and become damaged themselves, although recent advances have been made to minimize such damage. More problematic are drain blockages caused by shredded waste that is fibrous, e.g., artichoke leaves, or starchy, e.g., potato peelings.

Some higher-end units have an automatic reversing jam clearing feature. By using a slightly more-complicated centrifugal starting switch, the split-phase motor rotates in the opposite direction from the previous run each time it is started. This can clear minor jams, but is claimed to be unnecessary by some manufacturers: Since the late 1970s most disposal units have swivel impellers which make reversing unnecessary.

Some other kinds of garbage disposal units are powered by water pressure, rather than electricity. Instead of the turntable and grind ring described above, this alternative design has a water-powered unit with an oscillating piston with blades attached to chop the waste into fine pieces. Because of this cutting action, they can handle fibrous waste. Water-powered units take longer than electric ones for a given amount of waste and need fairly high water pressure to function properly.

Environmental impact

Kitchen waste disposal units increase the load of organic carbon that reaches the water treatment plant, which in turn increases the consumption of oxygen. Metcalf and Eddy quantified this impact as 0.04 pound of biochemical oxygen demand per person per day where disposers are used. An Australian study that compared in-sink food processing to composting alternatives via a life cycle assessment found that while the in-sink disposal performed well with respect to climate change, acidification, and energy usage, it did contribute to eutrophication and toxicity potentials.

This may result in higher costs for energy needed to supply oxygen in secondary operations. However, if the waste water treatment is finely controlled, the organic carbon in the food may help to keep the bacterial decomposition running, as carbon may be deficient in that process. This increased carbon serves as an inexpensive and continuous source of carbon necessary for biologic nutrient removal.

One result is larger amounts of solid residue from the waste-water treatment process. According to a study at the East Bay Municipal Utility District's wastewater treatment plant funded by the EPA, food waste produces three times the biogas as compared to municipal sewage sludge. The value of the biogas produced from anaerobic digestion of food waste appears to exceed the cost of processing the food waste and disposing of the residual biosolids (based on a LAX Airport proposal to divert 8,000 tons/year of bulk food waste).

In a study at the Hyperion (Los Angeles) sewage treatment works, disposer use showed minimal to no impact on the total biosolids byproduct from sewage treatment and similarly minimal impact on handling processes as the high volatile solids destruction (VSD) from food waste yield a minimum amount of solids in residue.

Energy usage is not high; typically 500 - 1500 W of power is used, comparable to an electric iron, but only for a very short time, totaling approximately 3-4 kWh of electricity per household per year. Daily water usage varies, but is typically one gallon of water per person per day, comparable to an additional toilet flush. One survey of these food processing units found a slight increase in household water use.

1.07 END QUESTIONS

Describe a professional kitchen

Explain the importance of kitchen

Describe ways to maintain the professional hygiene

What are the various sources of food spoilage?

How can we control the growth of bacteria?

Explain what is meant by Professional uniform.

What are the various considerations to be kept in mind while designing uniforms>

What are the various parts of a professional kitchen?

Explain classical kitchen brigade.

Describe the functions of the various chefs.

Describe what attributes the various chefs should possess to meet the professional needs

Explain how kitchen coordinates with the other staffs in hotel.

1.08 REFERENCES AND FURTHER READING

1. " Principle of cookery" by Mousumi Dasgupta (Published by Vikas Publication, Delhi for YCMOU)

2. "Training Manual for Food Preparation " by Sudhir Andrew, Tata Mc Graw Hill, Delhi

3. Wikipedia, (n.d.) "Garbage Disposal Unit."

UNIT 2: PRODUCTION EQUIPMENTS

2.0 INTRODUCTION

We have learned about the layout of the professional kitchen in the previous unit. We have seen what are the designation, duties, responsibilities and desirable attributes of the various staff of the professional kitchen. We also saw the precautions to be taken by the kitchen staff for maintaining kitchen hygiene at the personal level and at the place of work. We saw how the spoilage could be controlled by the various means. Thus, we have got ourselves accustomed with the place of our work for food production.

We now move on and would like to get introduced with the other players in the kitchen, namely our kitchen equipments. We would learn how to categorize and use them. We would learn how to use them safely. But despite our best efforts, if accidents do take place, we aught to know how to take care of the burns, cuts and other problems. Thus this unit, builds up on the previous knowledge and is important for every one who is to take the first steps in the kitchen. We will, in the rest of this course would learn how to prepare the food in the kitchen. However, before we prepare our first recipe, we should know how to handle kitchen equipments safely and effectively. This unit is going to ensure that.

2.1 UNIT OBJECTIVES

After studying this unit you will be able to

- ✓ Describe what is meant by kitchen equipments
- ✓ Classify the kitchen equipments
- ✓ Describe various types of kitchen equipments
- ✓ Explain how the various kitchen equipments are used
- ✓ Explain how various kitchen equipments are maintained and stored
- ✓ Describe the kitchen tools
- ✓ Describe various types of knives used in professional kitchens
- ✓ Explain how various types of knives are maintained
- ✓ Describe what is meant by workstations
- ✓ Describe various safety procedures used in a kitchen
- ✓ Explain various types of fuel
- ✓ Explain how various types of fuel are used
- ✓ Describe the safety measures to be taken up in use of various types of fuel
- ✓ Describe the various types of fires and how they are to be handled

- ✓ Describe various types of fire extinguishers
- ✓ Explain the first aid processes for burns
- ✓ Discuss how the cuts in accidents at kitchen are to be handled.

2.2 KITCHEN EQUIPEMENTS

Various types of equipments and machinery are used in a professional kitchen. They may be classified according to their sizes (small, medium, large), their purpose (cooking, storage, cooling and preservation, measurement, etc).

We will study the classification, use and description of these equipments in the following section.

2.3 CLASSIFICATION, DESCRIPTION AND USE OF KITCHEN EQUIPMENTS

The following are the various types of equipment used in commercial and domestic kitchen.

2.3.1 COOKING EQUIPMENTS

The following are some of the cooking equipments

STEAMERS

The following are two main types of steaming oven.

Atmospheric steaming oven

Fig 2.01: Atmospheric steaming oven (Source: http://nilma.com/eng/prodotti/scheda.jsp?gruppo=38#artundefined)

Pressure less steaming ovens

Fig 2.02: Pressure convection stremer combi oven (Source: https://www.amazon.com/Pressure-Convection-Steamer-CombiOven-10-10ESi/dp/B00FBPETAG)

Combination steam ovens; like Pressure convention steam ovens, pressure less or fully pressurized steam ovens, combination of steam air and hot air. The modern combination steamers are equipped

with electronic controls are précised in time and temperature. Electronic controls are beneficial as they are able to control the fuel efficiency. Steamers are used for steaming, poaching, stewing, braising, baking, vacuum cooking, blanching, reconstituting, and defrosting.

BRATT PANS

Fig 2.03: Electric Bratt Pan (source: http://www.chefsrange.co.uk/-firex-bm1e160i-185-ltr-electric-bratt-pan#.WaPdQ1FLfIU)

A multi purpose cooking equipment, a bratt pan can be used for shallow frying, deep frying, stewing, braising, and boiling. It can be used to cook many food items at a time because of its large surface area. Another advantage is that they can be tilted so that the content can be quickly poured out after being cooked. Bratt pans are heated using gas or electricity.

BOILING PANS

Boiling pans are usually made of metal such as aluminium, stain less steel etc. And they can be heated with the help of electricity or gas. These are generally used for boiling or stewing large quantities of food. They do not allow the food to burn. The steam- jacket type boiler is the most suitable.

PASTA COOKER

Fig 2.04: Electric Pasta Cooker (Source: https://www.foodequipment.com.au/jus-dm-2-benchtop-pasta-cooker.html)

This equipment has water delivery and drains taps and can be used for cooking several types of pastas simultaneously. It is electrically operated.

DEEP FAT FRYERS

A deep fat fryer is commonly used in the catering industry. This equipment should used cautiously as its misuse can result in spilling of food and fat. Fryers are equipped with a thermostatic control which saves fuel ad fat, and prevents over heating. They are heated with help of gas or electricity

PRESSURE FRYERS

Fig 2.05: Chicken Pressure Fryer (Source: http://www.ebay.com/bhp/chicken-pressure-fryer)

Food is cooked in an air tight frying vat which helps in frying the food lot faster at a low point temperature. Pressure fryers are commonly used in industrial kitchen.

HOT AIR ROTARY FRYERS

These are designed to cook batches of frozen blanched chips or battered food items without any oil in four to six minutes.

STEAM JACKET KETTLE

Various types of steam jacket kettles are available in different metals and sizes. These can be heated with the help of gas,electricity or steam from the main supply. Most of these are equipped with a tilting device to help empty the content easily.

HIGH PRESSURE BURNER RANGE

This equipment gives out intense heat and can be regulated and food can be cooked be used should be heavy in large quantities. The bottom of the pots and pans to

GRILLS AND SALAMANDERS

Salamanders or grills are heated from above by gas or electricity. These are often allowed to burn unnecessarily for long periods of time.Most salamanders have more than one set of heating elements or jets and it is not always necessary to have them all turned on fully.

Fig 2.06: Grill Salamander (source: https://www.ceonline.co.uk/catering-appliances/grills-salamanders.html)

CONTACT GRILLS

These are sometimes referred to as double side and two heating surfaces arranged, facing each other. The food to be cooked is placed on one surface and is then placed on one surface and is then covered by the second. Griddle with zone heating are useful as a portion of griddle can be heated without heating up the entire griddle.

FRY PLATES, GRIDDLE PLATES

These are solid metal plates heated from below and are used for cooking individual portions of meat, hamburgers, eggs, bacon, etc. They can be heated quickly to high temperature and are suitable for rapid and continuous cooking. Griddles with zone heating are useful as a portion of griddle can be heated without heating up the entire griddle.

BARBEQUES

Barbeques are becoming increasingly popular because they facilitate easy and quick cooking. There are three main types of barbeques- traditional charcoal, gas, and electric barbeque. Charcoal-fire type barbeque takes about an hour before the surface is ready to cook. In case of gas and electricity barbeque food can be cooked immediately. Gas is more flexible and controllable than electricity.

BAKING SHEETS

They are used in oven for baking; they are made up of aluminium or black metal. They are used for baking various cookies and bakery products.

2.3.2 STORAGE EQUIPMENT

The following are some of the storage equipment

HOT CUPBOARDS

Fig 2.07: Hot Cupboard (source: http://www.usscatering.co.uk/product-category/new-equipment/hot-cupboards-new-equipment/)

It is commonly known as HOT PLATE, hot cupboards are used for heating plates and serving dishes and for keeping food hot. It is necessary to maintain the amount of heat fed into the hot cupboard to be controlled; otherwise the plates and food will either be too hot or too cold.

BAIN MARIE

Fig 2.08: An improvised Bain Marie is used to cook Chocolate cake (source: Wikipedia, https://en.wikipedia.org/wiki/Bain-marie)

A brain Marie has open wells of water used for keeping food hot, and it is important that the brain Marie contains sufficient heat to boil the water.

STORAGE RACKS

These are commonly used in commercial and domestic kitchens for storing various food items. Both mobile and stationery racks are designed to accommodate a number of food items.

COFFEE AND MILK HEATERS

Water jacket boilers are equipped with draw off taps from the storage chamber and used to store hot coffee and hot milk. This equipment can be made up of glaze earthenware, stainless steel or heat resistant glass.

2.3.3. CLEANING EQUIPMENT

The following are some of the cleaning equipment

DISHWASHING MACHINES

Fig 2.09: Italy Conveyor Dish washing machine (source: http://www.21food.com/products/italy-conveyor-dish-washing-machine-dish-washing-line-734996.html)

For hygienic washing, the general requirement are a good supply of hot water at a temperature of 60 degree Celsius for general cleansing, followed by sterilizing rinse at a temperature of 82 degree Celsius for 1 minute. Alternatively low temperature equipment is available that chemically sterilizes utensils.

BOILERS

Boilers refer to water boiling appliances used for making tea and coffee. They can be of three types:

BULK BOILER:

These are generally used when large amount of boiling water is required at a given time. They should be kept clean, covered with a lid to prevent anything from falling in. When not in use, they should be left filled with clean water for some time.

AUTOMATIC BROILER:

Fig 2.10: Automatic broiler (source: http://www.mnmidwestfoodequipment.com/product_info.php?cPath=24_116&products_id=103)

These boilers have automatic water feeds and can give freshly boiled water at intervals. It is important that the water supply is maintained efficiently, otherwise there is a danger of the boiler burning dry and being damaged.

PRESSURE BOILER:

These boilers include steam heating milk boilers and a pressure boiler which provides boiling water. Especially attention should be given to the pilot light to see that it is working efficiently.

2.3.4 MEDIUM EQUIPMENT

2.3.4.1 Cooking equipment

The following are some of the commonly used cooking equipment:

(i)Stoves

Various types of stoves are available which use fuel, gas and electricity. The top of the stove should be cleaned pad. When cool, the stove can be cleaned more thoroughly by washing and using an abrasive such as emery paper. Light greasing of the slid top is essential after cleaning. In case of an

open type of stove, all the bars and racks should be removed, immersed in hot water with a detergent, scrubbed clean, dried and put back in place on the stove. After this, all gas jets should be lit to check it they are blocked. All enamel parts of the stove should be cleaned using detergent water, rinsed and dried.

If a lot of dirt grease is struck o to the stove oven, a caustic jelly can be used to remove it, though proper rinsing must take place after this, unnecessary lighting or lighting of stoves too early should be avoided as it can cause wastage of fuel.

(ii)Ovens and ranges

Various types of ovens are operated by electricity, gas, fuel or oil. Nowadays, microwave and microwave plus convention ovens are also available.

(iii) Convection Ovens

Fig 2.11: A convection oven (source: http://www.rollergrill-international.com/en/categorie/convection-ovens-165.html)

In convention ovens, a circulating hot air current is forced around the inside of the oven by a motorized fan or blower. This results in a constant and more even temperature, which facilitates cooking of food. Due to this, food can be cooked at lower temperatures and that too within a short period of time, thereby saving fuel.

Forced air convection can be characterized as fast conventional cooking as heat is applied to the surface of the food at a fast pace, since moving air transfers its heat more rapidly as compared to static air. In a sealed oven, fast hot air circulation reduces evaporation loss by minimizing the shrinkage and it brings about a rapid change in the surface in the surface texture and colour, which are traditionally associated with certain cooking processes.

The following are the four types of the convention ovens:

Convention ovens in which forced air circulation is accomplished within the oven, by means of a motor-driven fan. The rapid air circulation ensures even temperature distribution to all parts of the oven.

Convention ovens in which low-velocity and high-volume air movement is provided by a power blower and duct system.

A combination of a standard oven and a forced convection oven, which is designed to operate either of them by the flick of a switch.

A single roll-in rack convection oven with heating element and fan placed outside the cooking area.

(iv) COMBINATION OVENS

Combination ovens have brought about a revolution in baking, roasting and steaming. There are many varieties of combination ovens which are available in market, such as ovens fuelled by gas or electricity. These are extensively used in most sectors of the catering industry and also in large banqueting operations. These are pre-programmed and offer ideal producers for cooking different meats, especially roasts such as leg of lamp and roast pork. The special feature of a combination oven is that it automatically detects the size of the meat and volume of the food in the cooking cabinet.

An oven can be easily programmed to produce exact cooking time and to reheat chilled food, thereby allowing the chef to produce consistence products every time. The following are the special features of combination ovens:

They reduce cooking time.

They are fully automatic and help achieve the desired browning levels and exact core temperatures.

They are equipped with an automatic cleaning device.

A combination oven system allows more food to be produced in less space.

They provide efficiency in terms of energy.

They offer increased productivity.

(v) HOLD OVENS

Hold ovens reduce labour and product shrinkage, provide product consistency and increase the holding life for banqueting service. In these ovens, two items are available, one for holding and serving and the other one for regeneration and serving.

(vi) SMOKING OVENS

Fig 2.12: Smoking oven (source: http://appliancist.com/outdoor/outdoor_ovens/smoking-ovens-smokintex-electric-smoking-grills.html)

Smoking certain food items is a means of cooking by injecting a smoky flavour and preventing it. These ovens or cabinets are well insulated with controlled heating elements on which wood chips are placed. As the wood chips burn, the heated smoke permeates food such as fish, chicken, sausages, etc. Which are suspended in the cabinet.

(vii)MICROWAVE OVENS

Microwave cooking is a method of cooking and heating food by using high-frequency power. The energy used is the same as that which carries the television signal from the transmitter to the receiver, though it is at a higher frequency.

The waves disturb the molecules or food particles and agitate them, thus causing friction, which has the effect of heating the food. In the conventional method of cooking, heat penetrates the food only by conduction from the outside, whereas, food cooked by microwave needs no container before being put in the oven. Metal is not used in microwave ovens as the microwaves are reflected by it.

The oven cavity has metallic walls, ceiling and floor, which reflect the microwaves. The oven door is fitted with special seals to ensure that there is minimum microwave leakage. A cut-out device automatically switches off the microwave energy when the door is opened.

(viii)COMBINATION CONVECTION AND MICROWAVE COOKER

This cooker combines convection and microwave, thereby giving advantages such as speed, enhanced colour and texture of food. Traditional metal cooking pans may also be used without fear of damage to the cooker.

(ix) INDUCTION COOKING HOBS

In induction cooking hobs, heat is generated in the cooking pan itself. In conventional methods of cooking, energy is used to heat a source, which in turn heats the cooking vessel. In case of induction hobs, the pan becomes the source of heat and this is why induction cooking can be carried out only with the help of an induction pan placed on the induction plate. There is no visible light that gets transferred.

(x)HALOGEN HOBS

Halogen hobs run on electricity and comprises of five individually controlled heat zones, each of which has four tangents halogen lamps located under a smooth ceramic glass surface. The heat source glows red on being switched on and gets brighter as the temperature increases. When the hob is switched on, 70 per cent of the heat is transmitted as infra-red light directly into the base of the cooking pan and the rest is from conducted heat through the ceramic glass.

2.3.4.2 MECHANICAL EQUIPMENT

Mechanical equipment is commonly used in kitchens as they work efficiently and save labour and time. As machines are not subject to human variations, the performance of most machines can be closely controlled. Due to this, it also becomes easier to obtain uniformity of production over a period of time.

When some new equipment is installed, it should be tested by a qualified person before being used by the catering staff. The manufacturer's instructions must be considered while using it. The following are some of the commonly used mechanical equipment:

(I)Power driven machines

The following equipment is included in the category:

Worm-type mincing machines
Pie and tart making machines
Rotary knife, bowl-type chopping machines and dough mixers.
Food mixing machine used for mincing, slicing, chipping or for crumbling
Vegetables machines

(II)Potato peelers

Both manual and electric potato peelers are used in kitchens. These types of equipment also require proper care and maintenance. It should be ensured that potatoes are free of dirt before loading them in the machine. The inside of the machine must be cleaned after each use and the abrasive plate must be removed to ensure that food particles are not lodged below it. The peel trap should be emptied as often as required and the waste outlet should be kept free from obstruction.

3 .Food processing equipment

Food mixer

This is an important and labour-saving, electrically-operated equipment used for various purposes such as mixing pastries, cakes, mashing potatoes, mincing or chopping meat and vegetables, beating egg whites, mayonnaise cream, etc.

Liquidizer or Blender

A blender is a labour-saving piece of kitchen machinery that uses a high-speed motor to drive stainless steel blades to chop, puree or blend foods efficiently and quickly. It is also useful for making breadcrumb. As a safety precaution, food items must be cooled before being liquidized.

Food slicer

Food slicer are available both in manually and electrically-operated versions. They are labour-saving devices and should be placed in a prominent position near the machine. The following are some general precautions to be kept in mind while using food slicers. Care should be taken that no material which is likely to damage the blades is included in the food to be sliced. It is easy for a careless worker to overlook a piece of bone which, if allowed to come into contact with the cutting blade, can cause severe damage.

Each section in contact with food should be lubricated, but the oil used for this purpose must not come into contact with the food. Care should be taken while handling and exposing blades.

Chopper

A chopper is commonly used in kitchens for chopping vegetables and meats. It is available in electric and manually operated versions. The electric chopper should be thoroughly cleaned and dried after use and particular attentions should be paid to those parts that come into direct contact with food. It should be ensured that no obstruction prevents the motor from operating at its normal speed. Moving parts should be lubricated according to the manufacturer’s instructions.

Masher

Masher is used to crush soft food items, such as potatoes. These are available in both electrically and manually operated versions. A hand based masher must be washed immediately after use, followed by rinsing and drying. In case of an electric masher, the removable parts and the machine should be

separately washed and dried. Parts that come into direct contact with food should be handled with extra care.

Ice cream maker, juices and mixers

Ice cream and sorbet machines have minimum one litre capacity and enable establishments to produce home-made ice cream and sorbet using fresh fruits in season and canned fruits at all times of the year. Juicers and mixers can provide freshly made fruit and vegetable juices, milk shakes and cocktails.

2.3.5 Small Equipment and Utensils

2.3.5.1.Basic cutting tools

The following are the basic cutting tools required in every large kitchen:

(i)Knives

A good set of knives may be expensive but is an investment for a lifetime. The performance of a knife depends on two features—the quality of its steel and the excellence of its grind. The carbon content in a knife determines the hardness of its blades, which is essential for a sharp edge. A carbon steel knife will retain its sharp edge but it tends to react and turn black and will also rust if not dried properly after washing. On the other hand, stainless steel is a blend of carbon steel is a blend of carbon steel and chromium and does not mark or rust. However, because of the carbon content, stainless steel knives do not have a very sharp edge for a long time. It takes as much effort to keep a carbon steel knife clean as it takes to keep a stainless steel knife sharp. While selecting knives, designs should be considered as all knives are designed for specific purposes.

(ii) Butcher or Chopping Blocks

Chopping blocks are thick and durable wooden blocks which are primarily used for heavy chopping. These blocks have a tough surface and can therefore, withstand repeated heavy blows. They are used for cutting tough meats, especially in butcher shops.

A scraper should be used to keep the blocks clean. After scraping, the block should be sprinkled with common salt in order to absorb any moisture that may have penetrated during its use. Water or liquids should not be used for cleaning unless absolutely necessary, as wood may absorb water and cause swelling.

(iii) Cutting Boards or Chopping Boards

These boards are used to place foods to be cut on them. These are usually kept on table surfaces to protect the table from the edges of knives. Wooden cutting boards are commonly used in kitchens, though plastic and rubber cutting boards are also available.

2.3.5.2 Cooking equipment

The following are the cooking equipments required in every large kitchen:

(i)Pots and Pans

A standard commercial kitchen would have cooking utensils for specific uses, such as an omelette pan, a fry pan and a range of stainless steel pots of different sizes. While purchasing pots and pans, quality should be taken into consideration. It is better to buy a thick copper-based pan with a riveted handle than a thin and cheaper version that will dent, break or develop hot-spots. It should be ensured that pots have sturdy insulated handles and straight sides that curve gently at the base, so that there are no corners which are inaccessible to a spoon or whisky. The most commonly used top accessories are as follows:

(ii) Rolling pins, wooden spoons and spatulas

Rolling pins are cylindrical in shape and are primarily used to flatten dough. Generally, wooden rolling pins are used in kitchens. However, rolling pins made of glass and plastic are also available. These should be scrubbed in hot detergent water, rinsed in clean water and dried. They should never be scraped with a knife as this can cause the wood to splinter. Adhering pins cab be removed with a plastic capable of withstanding high temperatures. Wooden spoons and spatulas are commonly used while cooking in non-stick pans. These are considered unhygienic unless washed in a suitable sterilizing solution such as sodium hypo chloride solution (bleach) or Milton solution.

(iii) Wooden sieves and mandolins

Sieves are commonly used in kitchen for straining soups and other liquids. They are usually made of wood, though plastic sieves are also available. Mandolins are sharp instruments used for slicing of fruits and vegetables. While cleaning these, wooden frames should be washed in sterilizing solution. The blades of the mandolin should be kept lightly greased to prevent rust. Stainless-steel mandolins with protective guards are also available.

2.3.5.3. Crockery:

China and earthenware

Chinaware bowls and dishes are used for serving and are also used for placing dishes in microwave ovens. These should be cleaned in a dishwasher with a mild detergent and rinsed. They can also be washed by hand using an appropriate detergent.

REFRIGERATORS:

Refrigerators play an important role in the function of the garde manger as perishable food is stored at low temperature to prevent deterioration in the food and prevent growth of harmful bacteria.

Refrigerators should not be kept at deep freezing point that is 0-1 degree Celsius. A temperature of around 2-3 degrees is desirable. An effort must be made to keep the temperature constant. Following principles must be observed:

The refrigerator should be in good working order.

Check the thermostat to make sure it is functioning; have the refrigerator service regularly.
Deep frost regularly to enable the evaporator to function efficiently.
Use the door as little as possible and never leave it open longer than is necessary for keeping or withdrawing the food from the refrigerator.
Never place hot food in the refrigerator as it will rise the temperature and is harmful to the other food and cold storage.
When the refrigerator is being deep frosted it should be thoroughly cleaned.
The racks and bar should be scrubbed with water and detergent.
The wall door and floor of the refrigerator should be washed and sponged.

MINCING MACHINE AND BOWL CUTTER:

Mincing machine and bowl cutter is a combination machine. It is used for a number of functions in the garde manger like, mincing of meat for sausages, meat loafs, galantine, farce, mincing and chopping of cooked or raw food for various larder preparations.

The bowl cutter chops the food and useful for sausage meat, the mincer is used for breaking down bread and crust into bread crumbs which have been dried. The bowl cutter can be used for crumbing fresh crust less bread into crumbs. It can also be used for chopping vegetables.

Both the mincing and the bowl cutting attachment can be dismantled for cleaning which can be done with hot water containing detergent rinsed before reassembling. The machine should be lubricated at regular intervals.

SLICING MACHINE

The slicing machine is used for cutting slices of cooked meat such as ham, other joint of meat which is bone less. It is used for uncooked bacon rashers. A calibrated scale is fitted to determine the thickness of the slice. They may be manual, semi-automatic or fully automatic. For cleaning the machine should be dismantled and all parts washed in hot water and detergent. They should be rinsed before reassembling. The blades should be cleaned with cotton based and wooden palette. The machine should be kept lubricated.

SCALES AND WEIGHING MACHINE

Scales and weighing machine are of several types. Large platform scales are used for weighing large joints of meat and heavy weight. For lesser weights there are smaller scales such as graduated scales. No maintenance is required other than cleaning the scale.

When being weighed, food should not be placed directly on the platform or pans of the scales, a clean dish, a grease proof paper should be used.

ELECTRIC GRINDING MACHINE

Electric grinding machine is used for sharpening the blunt edges of knifes and choppers. The following instructions should be carefully observed:

Make sure there is sufficient water in the well and is pumped on the grind stone before using it. Never use the stone when it is dry.

Use the guides fitted to the machine for either knives or choppers.

Hold the handles of the knife in the right hand and draw the edge along the stone from the heel of the knife to the tip, with the stone moving in forward position and repeat the procedure with left side.

Keep the machine in a clean condition by sponging it and drying it.

Lubricate the machine with oil as per instructions.

BOILING PLATE OR GAS RINGS

Boiling plates or gas rings are used to heat or cook food, cooking vegetables for horsdoeuvre for rendering fat, for making jelly, sauce, pickles and other larder preparation. The flames must be controlled all the time to avoid burning of food. Spilling or boil over's should be wiped clean to prevent them from baking hard on the hot surface. The bar should be washed with hot water and detergent. The burners are required to be cleaned with hot water and detergent and wiped periodically. The fat drip tray must be emptied and cleaned daily. Do not allow crumbs to burn in the tray.

GAS BOILERS

The gas boilers are used for cooking large joints such as hams gammons and also for cooking lobster or crabs. The inner pans must be emptied, cleaned, washed and dried whenever used.

BUTCHERS BLOCKS

The butchers blocks are used for all butchery work including dissecting, jointing and cutting meat as well as cutting fats breaking and chopping bones. They are composed by joining a number of timber blocks framed around with a wooden frame. These butcher blocks are reversible that is, if one side is worn out it could be turned to use the other side. The surface should always be kept clean and dry. The top should never be scrubbed. It should be scrapped or brushed with the scraper or wire brushes provided and left to dry. Never wash the tools on the blocks.

STEEL TABLES

Steel tables are used as work benches but food must not be cut on them as it may create scratches on the work table and also make the edge of the knife blunt. The table should be cleaned with hot water with detergent and then rinsed with clean water and dried.

SAUCE PANS AND LIDS

Sauce pans and lids are made of aluminium. Certain food items cause discolouration of aluminium. The sauce pan should be washed in hot soupy water, polished to a bright sine with wire wool and soup. Soda must not be used for cleaning. Enamel trays are washed in hot soupy water rinsed and dried.

FRYING KETTLES AND FRYING PANS

The frying kettles are used for deep frying and rendering fats in drippings. The frying pans are used for a variety of shallow frying or sautéing. They are made up of steel and cleaned with a dry cloth.

KNIVES, CHOPPERS AND SAUCE

Knives choppers and sauce are made up of tempered steel and should be cleaned with detergent, hot water, rinsing and drying.

TOOL	USE
Butchers boning knives	Jointing and boning
Butchers steak knives	Cutting meat
Butchers saw	For surface ones
Butchers choppers	Chopping bones
Butchers chopping knives	Chining joints
Cooks 30cms knives	Poultry
Cooks 20-24cm knives	Vegetables
Cooks 6-8cm knives	Turning
Cooks 14-20cm filleting knives	Fish filleting
Palette knives	Lifting or turning food
Peeler	Peeling vegetables
Mandoline	Slicing vegetables

WOODEN UTENSILES

Wooden spatulas and spoons are used for stirring food and prevent burning. Wooden mushrooms are used for pressing food through sieves. These wooden utensils should be well scrubbed, washed, rinsed, and dried.

SMALL LARDER EQUIPMENTS

TOOLS	USE
Serving spoons and ladles	Spooning or ladling food

Sieves	Sieving various food item
Colanders	Draining food
Conical strainer and chinois	Straining sauce
Meat presses	Pressing joins
Pie moulds	Veal, pork, hams pie
Whisk	Whisking and stirring food
Egg slicer	Slicing hard boiled eggs
Graters	Grating food
Cutlet bat	Flattening cuts of meat
Trussing needle	Trussing poultry
Larding needles	Larding cuts of meat and poultry
Larding pin	Larding joints
Lemon zesters	Scrapping of lemon peal
Lemon decorators	Channelling lemon skin
Vegetable scoop	Shaping vegetables and potatoes
Skewers	Skewering meat
Brining syringe	Pumping brine into joints
Brinometer	Measuring density of brine

2.4 UPKEEP AND STORAGE

An increase in demand for quick food preparation and production in most food services areas has resulted in an increase in the number of machines. Nevertheless, machines can cause severe injuries, from a minor cut to a crushed limb. Thus, machines should not be operated until and unless one is instructed about their proper use. The following factors should be considered while using machines:

Machines should be in proper working order.
The operator should be trained to use the equipment.
Attachments should be correctly assembled and the correct equipment should be used to operate the machine.
Hands should be never placed inside the machine while it is in motion.

Power should be switched off and plugs removed from power points when the machines are to be cleaned.

2.5 KITCHEN TOOLS

A kitchen utensil is a hand-held, typically small tool that is designed for food-related functions. **Food preparation utensils** are a specific type of kitchen utensil, designed for use in the preparation of food. Some utensils are both food preparation utensils and eating utensils; for instance some implements of cutlery – especially knives – can be used for both food preparation in a kitchen and as eating utensils when dining.

In the Western world, utensil invention accelerated in the 19th and 20th centuries. It was fuelled in part by the emergence of technologies such as the kitchen stove and refrigerator, but also by a desire to save time in the kitchen, in response to the demands of modern lifestyles.

List

List of food preparation utensils

Name	Alternative names	Purpose in food preparation	Design	Image
Apple corer		To remove the core and pips from apples and similar fruits		
Apple cutter		To cut apple and similar fruits easily while simultaneously removing the core and pips.	Cf. peeler	
Baster		Used during cooking to cover meat in its own juices or with a sauce.	An implement resembling a simple pipette, consisting of a tube to hold the liquid, and a	

			rubber top which makes use of a partialvacuum t o control the liquid's intake and release. The process of drizzling the liquid over meat is called *basting* – when a pastry brush is used in place of a baster, it is known as a *basting brush*.	
Biscuit cutter	*Biscuit mould, Cookie cutter, Cookie mould*	Shaping biscuit dough	Generally made of metal or plastic, with fairly sharp edges to cut through dough. Some biscuit cutters simply cut through dough that has been rolled flat, others also imprint or mould the dough's surface.	

Biscuit press	*Cookie press*	A device for making pressed cookies such as spritzgebäck.	It consists of a cylinder with a plunger on one end which is used toextrude cooki e dough through a small hole at the other end. Typically the cookie press has interchangeable perforated plates with holes in different shapes, such as a star shape or a narrow slit to extrude the dough in ribbons.	
Blow torch	*Blowtorch, blowlamp*	Commonly used to create a hard layer of caramelized sugar in a crème brûlée.		
Boil over preventer	*Milk watcher, Milk guard, Pot minder*	Preventing liquids from boiling over outside of the pot	A disc with a raised rim, designed to ensure an even distribution of	

			temperature throughout the pot. This preventing bubbles from forming in liquids such as milk, or water which contains starch (for instance if used to cook pasta). Can be made of metal, glass or ceramic materials.	
Bottle opener		Twists the metal cap off of a bottle		
Bowl		To hold food, including food that is ready to be served	A round, open topped container, capable of holding liquid. Materials used to make bowls vary considerably, and include wood, glass and ceramic materials.	
Bread knife		To cut soft bread	A serrated blad e made of metal, and long enough to slice across a large loaf of bread.	

			Using a sawing motion, instead of pushing force as with most knives, it is possible to slice the loaf without squashing it.	
Browning tray	*Browning plate, Browning bowl*	Used in a microwave oven to help turn food brown	Generally made of glass or porcelain to absorb heat, which helps colour the layer of food in contact with its surface.	
Butter curler		Used to produce decorative butter shapes .		
Cake and pie server	*Cake shovel, pie cutter*	To cut slices in pies or cakes, and then transfer to a plate or container	This utensil typically features a thin edge to assist with slicing, and a large face, to hold the slice whilst transferring to a plate, bowl or other container.	
Cheese knife		Used to cut cheese.		

Cheesecloth		To assist in the formation of cheese	A gauzed cotton cloth, used to remove whey from cheese curds, and to help hold the curds together as the cheese is formed.	
Chef's knife		Originally used to slice large cuts of beef, it is now the general utility knife for most Western cooks.		
Cherry pitter	*Olive stoner*	Used for the removal of pits (stones) from cherries or olives.		
Chinois	*Chinoise*	Straining substances such as custards, soups and sauces, or to dust food with powder	A conical sieve	
Cleaver		Hacking through bone or slicing large vegetables (such as squash). The knife's broad side can also be used for crushing in food preparation (such as garlic).	A large broad bladed knife.	

Colander		Used for draining substances cooked in water	A bowl-shaped container with holes, typically made from plastic or metal. It differs from a sieve due to its larger holes, allowing larger pieces of food, such as pasta, to be drained quickly.	
Corkscrew		Pierces and removes a cork from a bottle.		
Crab cracker	*Lobster cracker*	Used to crack the shell of a crab or lobster	A clamping device, similar in design to a nutcracker but larger, with ridges on the inside to grip the shell.	
Cutting board		A portable board on which food can be cut.	Usually smaller and lighter than butcher's blocks, generally made	

			from wood or plastic.	
Dough scraper	*Bench scraper, Scraper, Bench knife*	To shape or cut dough, and remove dough from a worksurface	Most dough scrapers consist of handle wide enough to be held in one or two hands, and an equally wide, flat, steel face.	
Edible tableware			Tableware, such as plates, glasses, utensils and cutlery, that is edible	
Egg piercer		Pierces the air pocket of an eggshell with a small needle to keep the shell from cracking during hard-boiling. If both ends of the shell are pierced, the egg can be blown out while preserving the shell (for crafts).		

Egg poacher		Holds a raw egg, and is placed inside a pot of boiling water to poach an egg.		
Egg separator		A slotted spoon-like utensil used to separate the yolk of an egg from the egg white.		
Egg slicer		Slicing peeled, hard-boiled eggs quickly and evenly.	Consists of a slotted dish for holding the egg and a hinged plate of wires or blades that can be closed to slice.	
Egg timer		Used to correctly time the process of boiling eggs.	Historical designs range considerably, from hourglasses, to mechanical or electronic timers, to electronic devices which sense the water	

			temperature and calculate the boiling rate.	
Fillet knife		A long, narrow knife with a finely serrated blade, used to slice fine filet cuts of fish or other meat.		
Fish scaler	*Urokotori*	Used to remove the scales from the skin of fish before cooking		
Fish slice	*Spatula*, *turner*	Used for lifting or turning food during cooking		
Flour sifter		Blends flour with other ingredients and aerates it in the process.		
Food mill		Used to mash or sieve soft foods.	Typically consists of a bowl, a plate with holes like a colander, and a crank with a bent metal blade which crushes the	

			food and forces it through the holes.	
Funnel		Used to channel liquid or fine-grained substances into containers with a small opening.	A pipe with a wide, conical mouth and a narrow stem.	
Garlic press		Presses garlic cloves to create a puree, functioning like a specialized ricer.		
Grapefruit knife		Finely serrated knife for separating segments of grapefruit or other citrus fruit.		
Grater	*Cheese grater, Shredder*			
Gravy strainer	*Gravy separator*	A small pouring jug that separates roast meat drippings from melted fat, for making gravy.		
Herb		Chops or minces raw		

chopper		herbs.		
Honey dipper		Drizzles honey.		
Ladle		A ladle is a type of serving spoon used forsoup, stew, or other foods.		
Lame		Used to slash the tops of bread loaves inartisan baking.		
Lemon reamer		A juicer with a fluted peak at the end of a short handle, where a half a lemon is pressed to release the juice.		

Lemon squeezer		A juicer, similar in function to a lemon reamer, with an attached bowl.	Operated by pressing the fruit against a fluted peak to release the juice into the bowl.	
Lobster pick	*Lobster fork*	A long-handled, narrow pick, used to pull meat out of narrow legs and other parts of a lobster or crab		
Mandoline				
Mated colander pot				
Measuring cup	*Measuring jug,Measuring jar*		The Pyrex-brand traditional measuring cup (the Anchor Hocking-brand look-alike is shown, right) is available in 1 cup (8 ounce), 2 cup (16 ounce), 4 cup (32 ounce) and	

			8 cup (64 ounce) sizes and includes U.S. customary units in quarter, third, half and two-thirds cup increments, as well as metric units.	
Measuring spoon		Typically sold in a set that measures dry or wet ingredients in amounts from 1/4 teaspoon (1.25 ml) up to 1 tablespoon (15 ml).		
Meat grinder	*Mincer*	Operated with a hand-crank, this presses meat through a chopping or pureeingattachment.		
Meat tenderiser				

Meat thermometer				
Melon baller		Small scoop used to make smooth balls of melon or other fruit, or potatoes.		
Mezzaluna		To finely and consistently chop/mince foods, especially herbs.		
Mortar and pestle	*Molcajete*	To crush food, releasing flavours and aromas	Generally made from either porcelain or wood, the mortar is shaped as a bowl. The pestle, generally shaped like a small club, is used to forcefully squeeze ingredients such as herbs against the	

			mortar.	
Nutcracker		To crack open the hard outer shell of various nuts.		
Nutmeg grater		A small, specialized grating blade fornutmeg.		
Oven glove	*Oven mitt*	To protect hands from burning when handling hot pots or trays.		
Pastry bag		To evenly dispense soft substances (doughs, icings, fillings, etc.).		
Pastry blender		Cuts into pastry ingredients, such as flour and butter, for blending and mixing while they are in a bowl. It is made of wires curved into a crescent shape and held		

		by a rigid handle.		
Pastry brush	*Basting brush*	To spread oil, juices, sauce or glaze on food.	Some brushes have wooden handles and natural or plastic bristles, whilst others have metal or plastic handles and silicone bri stles.	
Pastry wheel		Cuts straight or crimped lines through dough for pastry or pasta.		
Peel	*Pizza shovel*			
Peeler	*Potato peeler*			
Pepper mill	*Burr mill, burr grinder, pepper grinder*			

Pie bird	*Pie vent, pie funnel*			
Pizza cutter	*Pizza slicer*			
Potato masher				
Potato ricer	*Ricer*	Presses very smooth vegetable mashes orpurees, operates similar to a meat grinder/mincer.		
Pot-holder				

Poultry shears		Used for dejointing and cutting uncooked poultry; reinforced with a spring, they have one serrated blade and pointed tips.		
Roller docker				
Rolling pin		A long, rounded wooden or marble tool rolled across dough to flatten it.		
Salt shaker				

Scales	*Kitchen scales, Weighing scales*			
Scissors	*Kitchen scissors*			
Scoop	*Ice cream scoop*			
Sieve	*Sifter, Strainer*			
Slotted spoon	*Skimmer*			

Spatula				
Spider	*Sieve, spoon sieve, spoon skimmer, basket skimmer*	For removing hot food from a liquid or skimming foam off when making broths	A wide shallow wire-mesh basket with a long handle	
Sugar thermometer	*Candy thermometer*	Measuring the temperature, or stage, of sugar		
Tamis	*Drum sieve*	Used as a strainer, grater, or food mill.	A tamis has a cylindrical edge, made of metal or wood, that supports a disc of fine metal, nylon, or horsehair mesh. Ingredients are pushed through the mesh.	
Tin opener	*Can opener*	To open tins or cans	Designs vary considerably; the earliest tin openers were knives, adapted to open a tin as easily as	

			possible.	
Tomato knife		Used to slice through tomatoes.	A small serrated knife.	
Tongs		For gripping and lifting. Usually used to move items on hot surfaces, such as barbecues, or to select small or grouped items, such as sugar cubes or salad portions.	Two long arms with a pivot near the handle.	
Trussing needle		For pinning, or sewing up, poultry and other meat.	Needle, about 20 cm long and about 3mm in diameter, sometimes with a blade at end for pushing through poultry	
Twine	*Butcher's twine, Cooking twine, Kitchen string, Kitchen twine*	For trussing roasts of meat or poultry.	Twine must be cotton—never synthetic—and must be natural—never bleached—in order to be "food grade".	

Whisk	*Balloon whisk, gravy whisk, flat whisk, flat coil whisk, bell whisk,*and other types.	To blend ingredients smooth, or to incorporate air into a mixture, in a process known as *whisking* or *whipping*	Most whisks consist of a long, narrow handle with a series of wire loops joined at the end. Whisks are also made from bamboo.	
Wooden spoon		For mixing and stirring during cooking and baking.		
Zester		For obtaining zest from lemons and othercitrus fruit.	A handle and a curved metal end, the top of which is perforated with a row of round holes with sharpened rims	 .

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2.6 USE CARE AND MAINTENANCE OF KNIVES

Knives

A cooking knife is very important equipment for any cook. So much so that cooks can be judged from the knives they use. The two most popular categories of knives are as follows:

1. Carbon steel knives (CSK)

2. Stainless steel knives (SSK)

CSK are quite easy to sharp and are not as expensive as SSK. However, they discolour during usage and rust if left in damp condition. SSK are avoided due to easy tainting and staining.

Types of handle design

Figure 2.13 shows the different parts of a knife.

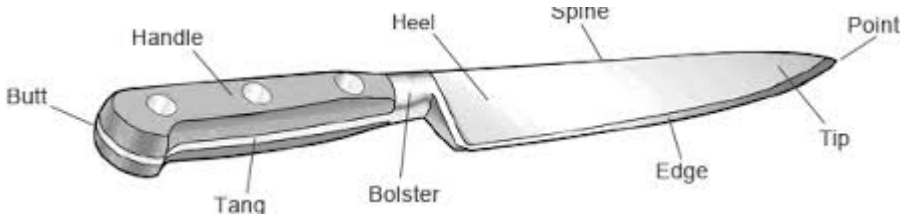

Fig 2.13: *Parts of Knife*

The types of handle design for knives are as follows:

1. **Pin tang knives:** In this type, the pin attaches the blade to the centre of the handle

2. **Scale tang knives:** In this type, the blade continues as a flange on to which the handle is fitted Key aspects of knives

The key aspects of knives are as follows:

- Good cooking and good knives go hand in hand.
- Size of the knife is a matter of individual suitability
- A good knife should be nimble and fine edged with a sheath to slip into harmlessly.
- Knives should be used on proper chopping boards with sufficient working space.
- A knife should be sharp at all times.
- Correct holding techniques and finger manipulation must be practiced.
- A knife should never be left in dirty/standing water.

Types of knives

The different types of knives are as follows:

1. **Boning shaped blade:** This is used to maneuvour raw and cooked boning.

2. **Vegetable knife:** This is a small blade with a small handle used for p and finishing. It measures about 4"-6".

3. **Cook's knife:** This is a long knife and measures about 10" — 12". It is u for chopping in almost all preparations.

4. **Billeting knife:** It is a long flexible knife used for skinning and fillet'

5. **Palette knives:** These are available in varying sizes and are used f moving and handling prepared food.

Knife safety

To avoid getting hurt with a knife, you must practice the following:

• Always keep your knives sharp. This way, it will slide easily through what: you are cutting, with little force involved. If the knife is dull, you will have to force it to do the cutting, and if you slip a little, you will get hurt.

• When you are using a knife, pay a lot of attention to where the edge of your sharp blade is pointing. Do not cut with the edge towards you or you: fingers, because if you slip the blade may hurt you.

• Do not leave sharp knives loose in a drawer as banging around in the drawer ruins their sharp edges.

• If you are working with or handling a knife, and you drop it, stand back and let it fall, do not try to catch it as that can really hurt.

• If you have a dirty knife, do not toss it in the dishwasher. There is a good chance that the dishwasher would ruin the good edge. Wash the knives separately.

• When you are working with a knife, do not lay it down with the edge pointing up. It is hard to see the edge, and someone may put his hand down on it, and get hurt.

2.00 END QUESTIONS

Describe what is meant by kitchen equipments

Classify the kitchen equipments

Describe various types of kitchen equipments

Explain how the various kitchen equipments are used

Explain how various kitchen equipments are maintained and stored

Describe the kitchen tools

Describe various types of knives used in professional kitchens

Explain how various types of knives are maintained

Describe various safety procedures used in a kitchen

Discuss how the cuts in accidents at kitchen are to be handled.

2.00 REFERENCES AND FURTHER READING

1. Wikipedia, List of Kitchen Utensils
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UNIT 3: MODERN TECHNIQUES IN FOOD PRODUCTION

3.01 INTRODUCTION

In this unit we will study various methods of cooking. As you are going to be a professional in hospitality studies, food production is one of the fundamental part of your study. We have studied certain basic concepts of food production in the last semester. We had studies various kitchen equipments, ingredients and soups, salads and stocks. We will now study the various methods used in cooking. It is obvious that the food production can not be studies without studying the concepts as basic as methods of cooking. We will see the basic types of cooking and study in depth various methods like baking, stewing, poching, rosting and cooking with microwave ovens.

3.01 UNIT OBJECTIVES

After studying this unit you will be able to

- Describe the concept of dry heat cooking and moist heat cooking
- Explain the cooking methods like baking, roasting etc
- Explain what is meant by HACCP standards kitchen

3.02 METHODS OF COOKING

Introduction

In cooking, there are some basic methods of cooking that are used. These commonly used basic cooking methods are divided into two general groups. The groups are: Dry heat cookery methods and Moist heat cookery methods. The methods of cooking are divided into these two groups because of the way food is cooked and the type of heat that is used. In this section we will introduce you with these methods in short. We will discuss these methods in details in the later sections. Let us have a look at the Dry Heat cookery methods.

Dry heat Cookery Methods

In dry heat cooking methods, the food being cooked does not use water to cook the food. The food is left dry and heat is applied to cook the food. Such methods of cooking are: baking, steaming, grilling, and roasting. When heat is applied to the food, the food cooks in its own juice or the water added to the food during its preparation evaporates during the heating process and this cooks the food. Heat is applied directly to the food by way of convection thus making the food to get cooked. The action or movement of air around the food, cooks it. Let us now have a look at each of these cooking methods

Baking

Fig 1.01: Bread is prepared using baking

In baking method of cooking, the food is cooked using convection heating. The food is put into an enclosed area where heat is then applied and the movement of heat within the confined space, acts on the food that make it get cooked.

Steaming

To steam food, water is added to a pot and then a stand is placed inside the pot. The water level should be under the stand and not above it. There is no contact between the food and the water that is added to the pot. Food is then placed on the stand and heat is applied. The hot steam rising from the boiling water acts on the food and the food gets cooked. It is the hot steam that cooks the food, as there is no contact between the food and the water inside the pot. This method of cooking for vegetables is very good as the food does not lose its flavour and much of the nutrients are not lost during the cooking.

Grilling

There are two methods of grilling that are used these days. One type of grilling is the one that is commonly used by the people in the village. This is when food is cooked over hot charcoal on an open fire. The food is placed on top of the burning charcoal. Sometimes people improvise by using wire mesh and place it over the open fire to grill fish or vegetables. The other method is using grills that are inbuilt in stoves. In this method, the griller, which has a tray, is heated up and the food is placed on the grill tray to cook. The heat can be gas-generated or electric-generated depending on the type of stove used. The food is again left to cook on the grill with the doors of the grill open. People who can afford to buy a stove would use the grilling part to grill their food. What happens in this type of cooking is the heat seals the outside part of the food and the juice inside the food cooks it. The flavour of the food is not lost and much of the nutrients are not lost either. Food is frequently turned over to prevent it from burning and to ensure that equal heating and cooking time is applied to both sides of the food. By doing this, the food is cooked evenly and thoroughly.

Roasting

Fig 1.02: Roasting

With roasting, direct heat is applied to the food. The heat seals the outside part of the food and the juice inside the food cooks the food. Roasting is mainly used when cooking fleshy food like fish, meat or chicken. When heat is applied to the outer covering of the food, it seals it up thereby trapping all the juices inside the food. The action of direct heating, heats up the juices inside the food, which then cooks the food. Again there is very little nutrient lost and the flavour is not spoilt. Food is frequently rotated over the spit so that there is even heating applied to all parts of the food. This is so that heat is applied evenly to the food to make it get cooked properly.

Moist Heat Cookery Methods

In moist heat cookery methods, liquid is used as a medium to cook the food. Such medium could be water, coconut cream or oil. These liquids are added to the food before heat is applied to it or sometimes heat is applied to the liquid before the food is added into the cooking utensils to be cooked. The moist heat cookery methods include: boiling, stewing, shallow frying, deep frying, barbequing and basting. All these moist heat cooking methods use liquid to cook the food in.

Boiling

This is the most common method of cooking and is also the simplest. With this method of cooking, enough water is added to food and it is then cooked over the fire. The action of the heated water makes the food to get cooked. The liquid is usually thrown away after the food is cooked. In the case of cooking rice, all the water is absorbed by the rice grains to make it get cooked. During the heating process, the nutrients can get lost or destroyed and the flavour can be reduced with this method of cooking. If you over cooked cabbage, all the nutrients can get lost.

Stewing

In the process of cooking using the stewing method, food is cooked using a lot of liquid. Different kinds of vegetables are chopped, diced or cubed and added to the pot. Sometimes pieces of selected meat, fish or chicken is also chopped and added to the stew. The liquid is slightly thickened and stewed food is served in that manner. This method is also used when preparing fruits that are going to be served as desserts. With this cooking method, every food is cooked together at the same time in one pot. The flavour, colours, shapes and textures of the different vegetables that are used, makes stewing a handy method of cooking. The only disadvantage is that some of the vegetables might be overcooked and thus the nutrient content becomes much less. It is therefore important that the vegetables that take the longest to cook to be put into the pot first and the ones that need least cooking to be put in last. In this way much of the nutrient contents of the food does not get lost.

Frying

When food is fried using oil or solid fat it is important that you observe some rules in handling oil or fat. *Simple rules to follow when frying:* 1.Make sure there is enough oil or fat put in the frying pan or a deep frying pan. 2.The food to be cooked must not have water dripping from it. This is because when water comes into contact with hot oil or fat, you will have the oil sizzling and spitting out of the pan, which could burn your skin if you are not careful. 3.Put the food into the hot oil carefully. Try not to make a big splash as the oil could burn your skin. 4.The oil of fat should be heated to the right temperature before putting food into the pan to be fried. If the food is put in when the oil or fat is not heated to the right temperature, the food will soak up the oil and you will have food that is all oily or greasy. If the oil or fat is over heated, you will end up with food that is burnt. Sometimes the food especially doughnuts will turn brown on the outside but the dough inside is uncooked. To cook food using the frying method, there are two ways of doing it. There is the shallow frying and the deep frying methods.

Shallow Frying

In shallow frying, food is cooked in a frying pan with a little amount of oil or fat. The oil or fat is heated to the correct amount and the food is put into the heated oil. The food is turned over a few minutes or is stirred around a couple of times before it is cooked and dished out. If patties, potato chips or coated foods are fried, it is best to put a piece of brown paper or paper napkin inside the tray to soak up any oil from the food before serving it.

Deep Frying

This is when a lot of oil or fat is used in cooking the food. The oil or fat is usually put into a deep pan and is heated to boiling point. Food is then put into the hot boiling oil and is cooked in that way. Such food as fish fingers, potato chips, meat balls, and dough nuts to name a few, are cooked using the deep frying method.

Barbequing

Fig 1.03: Barbequing

The method of cooking food by barbequing is usually associated with fund raising activities, parties or picnics. It is most suitable to cooking meat cutlets, fish or chicken pieces. The food is usually marinated with spices and tenderizers (for meat cuts) for sometime before it is cooked. With this method of cooking, a sheet of metal with stands is heated up and oil is used to cook the food. A sufficient amount of oil is heated up and food is added. The food is then turned over a couple of times before it is dished out.

Basting

This method of cooking is usually associated with roasting. The juice or liquid that comes out of the meat being cooked is spooned over the roast frequently while it is being roasted. The outer part of the meat is moistened frequently during the cooking process with the juice that is being spooned over. Usually, the extra juice from the cooked meat is added to a mixture to make the meat sauce.

CHECK YOUR PROGRESS

Which are the broad categories of cooking methods?
What is the difference between roasting and basting?
What is the difference between shallow and deep fryig?

1.03 BAKING

Baking is a method of cooking food that uses prolonged dry heat, normally in an oven, but also in hot ashes, or on hot stones. The most common baked item is bread but many other types of foods are baked. Heat is gradually transferred "from the surface of cakes, cookies, and breads to their centre. As heat travels through it transforms batters and doughs into baked goods with a firm dry crust and a softer centre". Baking can be combined with grilling to produce a hybrid barbecue variant by using both methods simultaneously, or one after the other. Baking is related to barbecuing because the concept of the masonry oven is similar to that of a smoke pit.

Because of historical social and familial roles, baking has traditionally been performed at home by women for domestic consumption and by men in bakeries and restaurants for local consumption. When production was industrialized, baking was automated by machines in large factories. The art of baking remains a fundamental skill and is important for nutrition, as baked goods, especially breads, are a common but important food, both from an economic and cultural point of view. A person who prepares baked goods as a profession is called a baker

Foods and techniques

Fig 1.04: A Palestinian woman baking markook bread on tava or Saj oven in Artas, Bethlehem

All types of food can be baked, but some require special care and protection from direct heat. Various techniques have been developed to provide this protection.

In addition to bread, baking is used to prepare cakes, pastries, pies, tarts, quiches, cookies, scones, crackers, pretzels, and more. These popular items are known collectively as "baked goods," and are often sold at a bakery, which is a store that carries only baked goods, or at markets, grocery stores, or through other venues.

Meat, including cured meats, such as ham can also be baked, but baking is usually reserved for meatloaf, smaller cuts of whole meats, or whole meats that contain stuffing or coating such as bread crumbs or buttermilk batter. Some foods are surrounded with moisture during baking by placing a small amount of liquid (such as water or broth) in the bottom of a closed pan, and letting it steam up around the food, a method commonly known as braising or slow baking. Larger cuts prepared without stuffing or coating are more often roasted, which is a similar process, using higher temperatures and shorter cooking times. Roasting, however, is only suitable for finer cuts of meat, so other methods have been developed to make tougher meat cuts palatable after baking. One of these is the method known as en croûte (French for "in a crust"), which protects the food from direct heat and seals the natural juices inside. Meat, poultry, game, fish or vegetables can be prepared by baking en croûte. Well-known examples include Beef Wellington, where the beef is encased in pastry before baking; pâté en croûte, where the terrine is encased in pastry before baking; and the Vietnamese variant, a meat-filled pastry called pâté chaud. The en croûte method also allows meat to be baked by burying it in the embers of a fire – a favourite method of cooking venison. In this case, the protective casing (or crust) is made from a paste of flour and water and is discarded before eating. Salt can also be used to make a protective crust that is not eaten. Another method of protecting food from the heat while it is baking, is to cook it en papillote (French for "in parchment"). In this method, the food is covered by baking paper (or aluminium foil) to protect it while it is being baked. The cooked parcel of food is sometimes served unopened, allowing diners to discover the contents for themselves which adds an element of surprise.

Fig 1.05: A terracotta baking mould for pastry or bread, representing goats and a lion attacking a cow. Early 2nd millennium BC, Royal palace at Mari, Syria

Eggs can also be used in baking to produce savoury or sweet dishes. In combination with dairy products especially cheese, they are often prepared as a dessert. For example, although a baked custard can be made using starch (in the form of flour, cornflour, arrowroot, or potato flour), the flavour of the dish is much more delicate if eggs are used as the thickening agent. Baked custards, such as crème caramel, are among the items that need protection from an oven's direct heat, and the bain-marie method serves this purpose. The cooking container is half submerged in water in another, larger one, so that the heat in the oven is more gently applied during the baking process. Baking a successful soufflé requires that the baking process be carefully controlled. The oven temperature must be absolutely even and the oven space not shared with another dish. These factors, along with the theatrical effect of an air-filled dessert, have given this baked food a reputation for being a culinary achievement. Similarly, a good baking technique (and a good oven) are also needed to create a baked Alaska because of the difficulty of baking hot meringue and cold ice cream at the same time.

Baking can also be used to prepare various other foods such as pizzas, baked potatoes, baked apples, baked beans, some casseroles and pasta dishes such as lasagne.

Equipment

Baking needs an enclosed space for heating – typically in an oven. The fuel can be supplied by wood, coal, gas, or electricity. Adding and removing items from an oven may be done by hand with an oven mitt or by a peel, a long handled tool specifically used for that purpose.

Many commercial ovens are equipped with two heating elements: one for baking, using convection and thermal conduction to heat the food, and one for broiling or grilling, heating mainly by radiation. Another piece of equipment still used for baking is the Dutch oven. "Also called a bake kettle, bastable, bread oven, fire pan, bake oven kail pot, tin kitchen, roasting kitchen, doufeu (French: "gentle fire") or feu de compagne (French: "country oven") [it] originally replaced the cooking jack as the latest fireside cooking technology," combining "the convenience of pot-oven and hangover oven."

Asian cultures have adopted steam baskets to produce the effect of baking while reducing the amount of fat needed.

Process

Eleven events occur concurrently during baking, some of which (such as starch glutenization) would not occur at room temperature.

- Fats melt;
- Gases form and expand
- Microorganisms die
- Sugar dissolves
- Egg, milk, and gluten proteins coagulate
- Starches gelatinise
- Gases evaporate
- Caramelization and Maillard browning occur on crust
- Enzymes are inactivated

- Changes occur to nutrients
- Pectin breaks down.

The dry heat of baking changes the form of starches in the food and causes its outer surfaces to brown, giving it an attractive appearance and taste. The browning is caused by caramelization of sugars and the Maillard reaction. Maillard browning occurs when "sugars break down in the presence of proteins". Because foods contain many different types of sugars and proteins, Maillard browning contributes to the flavour of a wide range of foods, including nuts, roast beef and baked bread." The moisture is never entirely "sealed in"; over time, an item being baked will become dry. This is often an advantage, especially in situations where drying is the desired outcome, like drying herbs or roasting certain types of vegetables.

Fig 1.06: Baking bread at the Roscheider Hof Open Air Museum

Fig 1.07:Baked goods

The baking process does not require any fat to be used to cook in an oven. When baking, consideration must be given to the amount of fat that is contained in the food item. Higher levels of fat such as margarine, butter, lard, or vegetable shortening will cause an item to spread out during the baking process.

With the passage of time, breads harden and become stale. This is not primarily due to moisture being lost from the baked products, but more a reorganization of the way in which the water and starch are associated over time. This process is similar to recrystallization and is promoted by storage at cool temperatures, such as in a domestic refrigerator or freezer.

CHECK YOUR PROGRESS

Describe baking.
What happens to the food during the process of baking?
What food items can be baked? Describe baking of meat in particular.

3.04 BROILING

According to Encyclopedia Britannica:

"Broiling**,** is cooking by exposing food to direct radiant heat, either on a grill over live coals or below a gas burner or electric coil. Broiling differs from roasting and baking in that the food is turned during the process so as to cook one side at a time. Temperatures are higher for broiling than for roasting; the broil indicator of a household range is typically set around 550 °F (288 °C), whereas larger commercial appliances broil between 700 and 1,000 °F (371 and 538 °C)."

Fish, fowl, and most red meats are suitable for broiling. Steaks, popularly broiled over coals, can also be broiled in skillets or in the oven set on a seasoned wooden plank. In preparation of the entrée known as the London broil, or London mixed grill, flank steaks and other meats are garnished with vinegar, oil, and minced garlic before being placed on a rack and oven-broiled.

How to use a broiler?

Many modern cooks avoid broilers because they don't know how to use them. However, broilers are useful tools that can cook or toast food in a matter of minutes. First, set an oven rack close to the top of the oven. Next, turn on your broiler. Let it preheat for five to ten minutes before placing your food in the oven. Make sure to use sturdy metal or cast iron pans when broiling your food.

Part 1: Turning On the Broiler

Step 1

Find the broiler. Older gas ovens have a drawer at the bottom of the oven that contains the broiling unit. This compartment is commonly called the “broiler drawer.” If your oven doesn’t have a broiler drawer, the broiler is inside the main oven compartment. In this case, the broiling unit in will be attached to the top of the oven interior.

Step 2

Arrange the oven rack. Most recipes ask you to place the rack 3-4 inches (7.5 to 10 centimeters) away from the broiler. To do so, move the oven rack to one of the top two rack positions. Use a ruler to measure the distance from the rack to the top of the oven.

If you’re oven has a broiler drawer, you will not be able to adjust the shelf height.

Step 3

Turn on the broiler. If you have a gas oven, the broil setting will be the last setting on the temperature dial. Depending on the model, an electric oven can have a “broil” button or a broil option on the temperature dial. To turn on the broiler, simply press the “broil” button or turn dial all the way to the word “broil.”

Some newer electric ovens have several broiling settings. If the recipe doesn’t specify a temperature, use the highest setting.

Step 4

Preheat the oven. Close the broiler drawer or oven door. Let the oven preheat for at least five minutes before cooking any food. Some meat recipes will call for longer preheating times to help sear the surface of the meat.

Part 2: Using the Broiler

Step 1

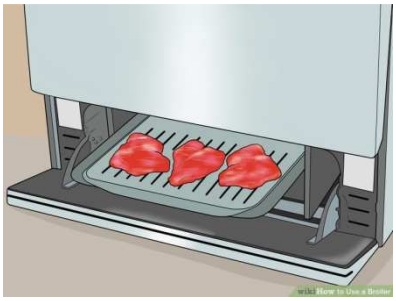
Use the right pans. Avoid putting glass or Pyrex dishes under your broiler. These materials may crack or explode when exposed to the high temperatures in a broiler. Instead, use sturdy metal or cast iron pans. For example:

Cast iron pans are usually preheated with the broiler. These pans are great for searing meat.

Metal baking sheets can be lined with foil and used to broil toast or vegetables.

Slotted broiling pans have an extra tray underneath that circulates heat and catches draining fat. These trays can be used for any kind of food.

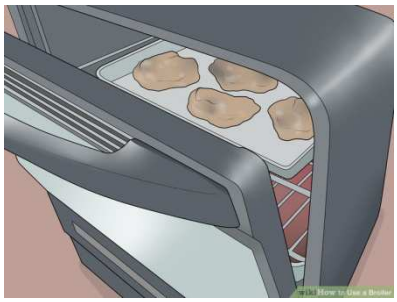
Step 2



Align your food underneath the flame. This method only applies to gas ovens. Once the broiler is on, look inside the oven to find the flames. When you place food in the oven, try to center it directly underneath these flames.

Electric ovens use heated coils instead of flames to broil food. These coils are usually evenly distributed along the top of the oven.

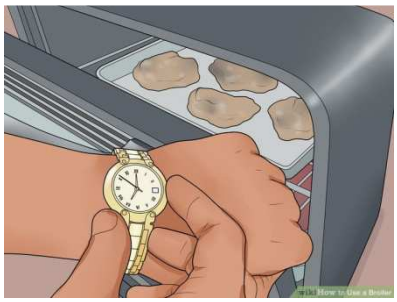
Step 3



Leave the door cracked. Leaving the oven door or broiler drawer slightly open will allow air and heat to circulate evenly. However, not all oven units will operate with an open door. Check your oven's manufacturer manual to find out.

If you have small children in your home, leave the oven door or broiler drawer closed to avoid any accidents.

Step 4



Monitor your food closely. Broilers use high temperatures to quickly sear food. Therefore, most recipes only ask you to broil food for 5-10 minutes. If you leave the food in too long, it could burn or even catch on fire. This is especially true for dry foods such as toast. If your food catches on fire:

Turn off the broiler.

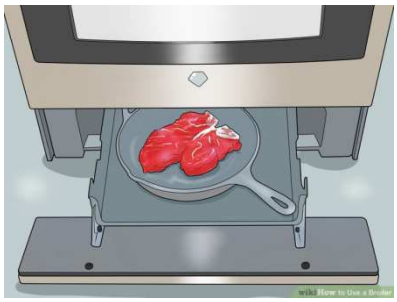
Leave the oven door or drawer closed. If the door is open, close it. This will cut off the oxygen supply to the fire.

Let the fire burn out on its own. Open a window to ventilate any smoke.

Keep an eye on your oven. If the fire gets bigger or the flames start coming out of your oven, evacuate your home and call your local emergency hotline.

Part 3: Broiling Your Food

Step 1

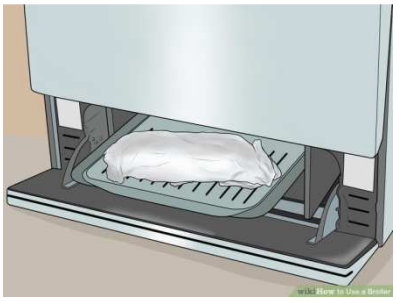


Broil a steak. First, place a cast iron skillet in the broiler. Preheat the oven and the skillet for 15-20 minutes. Next, place a seasoned steak in the hot cast-iron skillet. Broil the steak for three to five minutes per side. After the steak is cooked, let it rest for at least five minutes before serving it.

Season the steak by brushing it with olive oil and sprinkling on a layer of salt and pepper.

Let the steak come to room temperature on your counter before cooking it.

Step 2



Toast garlic bread. Cut a loaf of French bread into large pieces about 1-2 inches (2.5-5 centimeters) thick. Next, spread a liberal amount of seasoned butter onto each slice. Place the bread on a foil-wrapped baking sheet and broil it for 5 minutes. Keep a close eye on the bread to make sure it doesn't burn. Create a savory seasoned butter by combining:

5 tablespoons of softened butter

2 teaspoons of extra virgin olive oil

3 cloves of crushed garlic

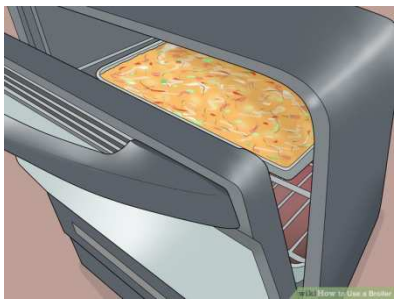
1 teaspoon of dried oregano

salt and pepper to taste

Step 3

Grill sliced veggies. This method of cooking softens vegetables while giving them a smoky, charred flavor. First, toss thinly chopped vegetables in olive oil and sprinkle them with salt and pepper. Next, place them on a foil lined baking sheet and broil them for 20 to 25 minutes, stirring them every five minutes. This method works for many vegetables, including: Carrots, Bell peppers, Onions, Zucchini, Potatoes.

Step 4



Finish casseroles in the broiler. Use your broiler to add a golden baked finish to the top of your casseroles. First, cook your favorite casserole in the oven. Once it's almost done cooking, place it under the broiler. Broil the casserole for three to five minutes before removing it to cool.

Let the casserole cool for five to ten minutes before eating it.

CHECK YOUR PROGRESS

What is the difference between roasting and broiling?
Describe the steps in turning on the broiler?
What are the steps in using the broiler?

3.05 GRILLING

Grilling is a form of cooking that involves dry heat applied to the surface of food, commonly from above or below. Grilling usually involves a significant amount of direct, radiant heat, and tends to be used for cooking meat quickly. Food to be grilled is cooked on a grill (an open wire grid such as a gridiron with a heat source above or below), a grill pan (similar to a frying pan, but with raised ridges to mimic the wires of an open grill), or griddle (a flat plate heated from below).

Fig 1.08: Close-up view of meat fillets being grilled

Heat transfer to the food when using a grill is primarily through thermal radiation. Heat transfer when using a grill pan or griddle is by direct conduction. In the United States, when the heat source for grilling comes from above, grilling is called broiling. In this case, the pan that holds the food is called a broiler pan, and heat transfer is through thermal radiation.

Fig 1.09: Hamburgers being grilled over a charcoal fire

Direct heat grilling can expose food to temperatures often in excess of 260 °C (500 °F). Grilled meat acquires a distinctive roast aroma and flavor from a chemical process called the Maillard reaction. The Maillard reaction only occurs when foods reach temperatures in excess of 155 °C (310 °F).

Studies have shown that cooking beef, pork, poultry, and fish at high temperatures can lead to the formation of heterocyclic amines, benzopyrenes, and polycyclic aromatic hydrocarbons, which are carcinogens. Marination may reduce the formation of these compounds. Grilling is often presented as a healthy alternative to cooking with oils, although the fat and juices lost by grilling can contribute to drier food.

Health risks

As is true of any high-temperature frying or baking, when meat is grilled at high temperatures, the cooking process can generate carcinogenic chemicals. Two processes are thought to be responsible. Heterocyclic amines (HCAs) are formed when amino acids, sugars, and creatine react at high temperatures. Polycyclic aromatic hydrocarbons (PAHs) are formed when fat and juices from meat grilled directly over an open fire drip onto the fire, causing flames. These flames contain PAHs that then adhere to the surface of the meat.

However it is possible to significantly reduce carcinogens when grilling meat, or mitigate their effect. Garlic, rosemary, olive oil, cherries, and vitamin E have been shown to reduce formation of both HCAs and PAHs. V-profiled grill elements placed at an angle may help drain much of the meat juices and dripping fat, and transport them away from the heat source. Heat sources on the top (as in many electrical or gas ovens), or on the side (vertical grilling) avoid completely the burning of fat dripping from the meat, and the meat's contact with the flames. Another method is precooking the meat in the microwave, which can reduce HCA formation by reducing the time that meat must be in contact with high heat to finish cooking.

Methods

Gridironing

Fig 1.10: Food cooking on a charcoal grill

Fig 1.11: Preparation of a barbecue grill

Gridironing is the cooking of meats or other foods using a grill suspended above a heat source. Grilling is often performed outdoors using charcoal (real wood or preformed briquettes), wood, or propane gas. Food is cooked using direct radiant heat. Some outdoor grills include a cover so they can be used as smokers or for grill-roasting/barbecue. The suspended metal grate is often referred to as a gridiron.

Fig 1.12: Grilling chicken in a hinged gridiron

Outdoor grilling on a gridiron may be referred to as "barbecue", though in US usage, the term barbecue refers to the cooking of meat through indirect heat and smoke. Barbecue has several meanings and may be used to refer to the grilled food itself, to a distinct type of cooked meat called Southern barbecue, to the grilling device used to cook the food (a barbecue grill), or to the social event of cooking and eating such food (which may also be called a cook-out or braai).

Charcoal kettle-grilling

Charcoal kettle-grilling refers to the process of grilling over a charcoal fire in a kettle, to the point that the edges are charred, or charred grill marks are visible. Some restaurants seek to re-create the charcoal-grilled experience via the use of ceramic lava rocks or infrared heat sources, offering meats that are cooked in this manner as "charcoal-cooked" or "charcoal-grilled".

Grill-baking

By using a baking sheet pan placed above the grill surface, as well as a drip pan below the surface, it is possible to combine grilling and roasting to cook meats that are stuffed or coated with breadcrumbs or batter, and to bake breads and even casseroles and desserts. When cooking stuffed or coated meats, the foods can be baked first on the sheet pan, and then placed directly on the grilling surface for char marks, effectively cooking twice; the drip pan will be used to capture any crumbs that fall off from the coating or stuffing.

Grill-braising

It is possible to braise meats and vegetables in a pot on top of a grill. A gas or electric grill would be the best choices for what is known as "barbecue-braising" or "grill-braising", or combining grilling directly on the surface and braising in a pot. To braise on a grill, put a pot on top of the grill, cover it, and let it simmer for a few hours. There are two advantages to barbecue-braising. The first is that this method allows for browning the meat directly on the grill before the braising, and the second is that it also allows for glazing the meat with sauce and finishing it directly over the fire after the braising,

effectively cooking the meat three times, which results in a soft textured product that falls right off the bone. This method of cooking is slower than regular grilling but faster than pit-smoking, starting out fast, slowing down, and then speeding up again to finish. If a pressure cooker is used, the cooking time will be much faster.

Indoor grilling

Many restaurants incorporate an indoor grill as part of their cooking apparatus. These grills resemble outdoor grills, in that they are made up of a grid suspended over a heat source. However, indoor grills are more likely to use electric or gas-based heating elements. Some manufacturers of residential cooking appliances now offer indoor grills for home use, either incorporated into a stove top or as a standalone electric device.

Sear grilling

Sear-grill and gear grilling is a process of searing meat or food items with an infrared grill. In sear grilling, propane or natural gas is used to heat a ceramic plate, which then radiates heat at temperatures over 480 °C (900 °F).

Sear-grilling instantly sears the outside of meat to make the food more flavorful. Commonly, grilling heats the surrounding air to cook food. In this method, the infrared grill directly heats the food, not the air.

Stove-top pan grilling

Fig 1.13: A grill pan

Stove-top pan grilling is an indoor cooking process that uses a grill pan — similar to a frying pan but with raised ridges to emulate the function or look of a gridiron. In pan grilling, heat is applied directly to the food by the raised ridges and indirectly through the heat radiating off the lower pan surface by the stove-top flame. Stove-top grill pans can be used to put sear marks on meat before it is finished by overhead radiant heat. When cooking leaner meats, oil is often applied to the pan ridges to aid in food release.

Some griddles designed for stove-top use incorporate raised ridges in addition to a flat cooking area. These are either on half of the cooking surface or, in the case of reversible two-sided griddles, on one side with the flat surface on the other.

Flattop grilling

Fig 1.14: Cooks at the Northern Lights Dining Room, Seattle, Washington, 1952. A flattop grill being used is located on the right.

Foods termed "grilled" may actually be prepared on a hot griddle or flat pan. The griddle or pan may be prepared with oil (or butter), and the food is cooked quickly over a high heat. Griddle-grilling is best for relatively greasy foods such as sausages. Some griddle-grilled foods may have grill marks applied to them during the cooking process with a branding plate, to mimic the appearance of charbroil-cooked food.

A flattop grill is a cooking appliance that resembles a griddle but performs differently because the heating element is circular rather than straight (side to side). This heating technology creates an extremely hot and even cooking surface, as heat spreads in a radial fashion over the surface.

The first flattop grills originated in Spain and are known as planchas or la plancha. Food that is cooked a la plancha means grilled on a metal plate. Plancha griddles or flat tops are chrome plated which prevents reaction with the food. Some base metal griddles will impart a subtle flavor to the food being cooked.

The flattop grill is a versatile platform for many cooking techniques such as sautéing, toasting, steaming, stir frying, grilling, baking, braising, and roasting, and can also be used in flambéing. In addition, pots and pans can be placed directly on the cooking surface for even more cooking flexibility. In most cases, the steel cooking surface is seasoned like cast iron cookware, providing a natural non-stick surface.

Charbroiling

Charbroiling, or chargrilling outside North America, refers to grilling on a surface with wide raised ridges, to the point of having the food slightly charred in texture.

Overhead grilling

In the United States, oven pan broiling refers to a method of cooking inside an oven on a broil pan with raised ridges, where the heat can be applied from either above or below. In gas and electric ovens, this is accomplished with a heating element and a broil pan. Sometimes, the food is placed near the upper heating element to intensify the heat. The lower heating element may or may not be left off and the oven door is sometimes opened partially. Gas ovens often have a separate compartment for broiling, sometimes a drawer below the bottom flame.

Salamander

A salamander is a culinary grill characterized by very high temperature overhead electric or gas heating elements. It is used primarily in professional kitchens for overhead grilling (US: broiling). It is also used for toasting, browning of gratin dishes, melting cheeses onto sandwiches, and caramelizing desserts such as crème brûlée.

Salamanders are generally similar to an oven without a front door, with the heating elements at the top. They are more compact; typically only half the height and depth of a conventional oven. They are often wall mounted at eye level, enabling easy access and close control of the cooking process. Many salamanders can be fitted with a cast iron "branding" plate which is used to make grill marks on the surface of meat. Some grills can also be fitted with a rotisserie accessory for roasting meats.

Overhead heat has the advantage of allowing foods containing fats, such as steaks, chops and other cuts of meat, to be grilled without the risk of flare-ups caused by the rendered fat dripping onto the heat source. The salamander's facility for extremely high temperature also takes less cooking time than other grilling techniques, reducing preparation time, which is a benefit in professional kitchens during a busy meal service.

Modern salamanders take their name from the 18th century salamander, the tool of choice for toasting the top of a dish. It consisted of a thick plate of iron attached to the end of a long handle, with two feet, or rests, arranged near the iron plate for propping the plate over the food to be browned. Its name in turn was taken from the legendary type of salamander, a mythical amphibian that was believed to be immune to fire.

Two-sided grilling

Some commercial devices permit the simultaneous grilling of both sides of the meat at the same time.

The flame-grilling machine at Burger King, Carl's Jr./Hardee's, and other fast food restaurants is called a 'broiler'. It works by moving meat patties along a chain conveyor belt between top and bottom burners, grilling both sides of the meat patty at the same time. This concept was invented in 1898, when the Bridge and Beach Co. of St. Louis, Missouri, started manufacturing a vertical cast iron stove. These stoves were designed to allow the meat to be flame-broiled (flame-grilled) on both sides at the same time. Custom hinged steel wire gridirons were built for use in the vertical broilers. The

hinged gridirons were slid in and out of the stoves holding the meat while it cooked evenly on both sides, like modern day oven racks. These stoves took up a small amount of counter space. They were used in lunch spots to feed factory workers.

During the 1990s, double-sided grilling was popular in the USA using consumer electrical grills (e.g., the popular George Foreman Grill). US marketers of electric double-sided grilling appliances opted for the global term 'grilling' rather than the geographically isolated term "broiler." Hinged double-sided grills are generically known as contact grills.

Stone grills

Sometimes a stone is used to grill foods. Stones in these cases can store temperatures up to 450 °C (842 °F). Foods grilled on stone involve no fats or oil and are considered a healthier alternative.

Whole grilling

Whole grilling involves grilling a whole carcass as opposed to grilling individual portion sized cuts. This method is often used in order to avoid the need for complicated grill equipment during, for example, a hunt or expedition in the wild. It is also the traditional method of cooking in several cultures where they do a pig roast, luau, or barbacoa. There are several primitive methods and modern equipment that copies and automates the primitive version:

(a) On a stick

- Rotating horizontally with heat from tall flames on the side: In this version, which essentially is one sided vertical grilling, it is usual to spice and sew the body enclosures, with sticks in order to save the juices, rotate back and forth (never seamline at bottom), harvest the juice at the end of grilling, and use it as a spicy sauce over the outside surface.
- Rotating horizontally over embers: In this version the meat may be subject to smoke from dripping fat that burns.
- Planted in a heated and covered pit: a ground hole version of tandoori or oven. A covered pit makes it difficult to check the correct amount of cooking time.

(b) Asado on a vertical frame planted and leaned over embers: In this version it is usual to open the torso to avoid portions that might not get cooked.

(c) Hang in a heated and covered pit (requires stick across the pit opening, and a heat-resistant hanging mechanism such as a metal S hook)

(d) On a tray in a large oven, heated and covered pit, barbeque grill or smoker

In a fireproof closed container buried in embers or surrounded by fire: this is practical for small carcasses like whole chicken. One variation of this is to shallowly bury the food and make a fire over, just to dig it up again; This is suitable to whole grill a large pumpkin that has been opened, seeds removed, the inside sugared, and closed again.

CHECK YOUR PROGRESS

To what category of cooking methods does “grilling” belong?
What are the various methods of grilling describe any two in details.

What are the health risks of consuming grilled food?

3.06 FRYING

Frying is the cooking of food in oil or another fat. Chemically, oils and fats are the same, differing only in melting point, and the distinction is only made when needed. Foods can be fried in a variety of fats, including lard, vegetable oil, rapeseed oil and olive oil. In commerce, many fats are called oils by custom, e.g. palm oil and coconut oil, which are solid at room temperature. A variety of foods may be fried, including the potato chip, bread, eggs and foods made from eggs, such as omelettes or pancakes.

Fig 1.15: A painting by the Russian artist A. I. Morozov showing frying in the open air

Fats can reach much higher temperatures than water at normal atmospheric pressure. Through frying, one can sear or even carbonize the surface of foods while caramelizing sugars. The food is cooked much more quickly and has a characteristic crispness and texture. Depending on the food, the fat will penetrate it to varying degrees, contributing richness, lubricity, and its own flavor, as well as calories.

Fig 1.16: Tofu being fried

Frying techniques vary in the amount of fat required, the cooking time, the type of cooking vessel required, and the manipulation of the food. Sautéing, stir frying, pan frying, shallow frying, and deep frying are all standard frying techniques.

Pan frying, sautéing and stir-frying involve cooking foods in a thin layer of fat on a hot surface, such as a frying pan, griddle, wok, or sauteuse. Stir frying involves frying quickly at very high temperatures, requiring that the food be stirred continuously to prevent it from adhering to the cooking surface and burning.

Shallow frying is a type of pan frying using only enough fat to immerse approximately one-third to one-half of each piece of food; fat used in this technique is typically only used once. Deep-frying, on the other hand, involves totally immersing the food in hot oil, which is normally topped up and used several times before being disposed. Deep-frying is typically a much more involved process, and may require specialized oils for optimal results.

Deep frying is now the basis of a very large and expanding worldwide industry. Fried products have consumer appeal in all age groups and in virtually all cultures, and the process is quick, can easily be made continuous for mass production, and the food emerges sterile and dry, with a relatively long shelf life. The end products can then be easily packaged for storage and distribution. Examples are potato chips, french fries, nuts, doughnuts, instant noodles, etc.

CHECK YOUR PROGRESS

What is meant by frying?
What is the difference between deep and shallow frying?
What is stir frying?

3.07 STEWING

A stew is a combination of solid food ingredients that have been cooked in liquid and served in the resultant gravy. Ingredients in a stew can include any combination of vegetables (such as carrots, potatoes, onions, beans, peppers and tomatoes) or meat, especially tougher meats suitable for slow-

cooking, such as beef. Poultry, sausages, and seafood are also used. While water can be used as the stew-cooking liquid, wine, stock, and beer are also common. Seasoning and flavourings may also be added. Stews are typically cooked at a relatively low temperature (simmered, not boiled), allowing flavors to mingle.

Stewing is suitable for the least tender cuts of meat that become tender and juicy with the slow moist heat method. This makes it popular in low-cost cooking. Cuts having a certain amount of marbling and gelatinous connective tissue give moist, juicy stews, while lean meat may easily become dry.

Stews may be thickened by reduction or with flour, either by coating pieces of meat with flour before searing, or by using a roux or beurre manié, a dough consisting of equal parts of fat and flour. Thickeners like cornstarch or arrowroot may also be used.

Stews are similar to soups, and in some cases there may not be a clear distinction between the two. Generally, stews have less liquid than soups, are much thicker and require longer cooking over low heat. While soups are almost always served in a bowl, stews may be thick enough to be served on a plate with the gravy as a sauce over the solid ingredients.

Fig 1.17: Lamb and lentil stew

The following are some of the stews of India:

1. Daal (the Indian legume stew that has many varieties, a staple food throughout Asia)

2. Sambhar (a thick vegetable stew, from South India)

3. Ishtu (a curry in Kerala, India made from chicken or mutton, potato and coconut milk)

4.Pulusu (a form of stew from Andhra Pradesh in India that is typically sour and cooked with tamarind paste)

Fig 1.18: Dal tadka served with rice and papadam, staple meal in South Asia

Fig 1.19: Sambhar

CHECK YOUR PROGRESS

How can we describe a stew?
What kind of meat is suitable for making stew?
What are similarities between stew and soup?

3.08 POACHING

Poaching is a type of moist-heat cooking technique that involves cooking by submerging food in a liquid, such as water, milk, stock or wine. Poaching is differentiated from the other "moist heat" cooking methods, such as simmering and boiling, in that it uses a relatively low temperature (about 160–180 °F (71–82 °C)). This temperature range makes it particularly suitable for delicate food, such as eggs, poultry, fish and fruit, which might easily fall apart or dry out using other cooking methods. Poaching is often considered as a healthy method of cooking because it does not use fat to cook or flavor the food.

Variations

Shallow poaching

This moist-heat cooking method uses a sautoir or other shallow cooking vessel, heat is transferred by conduction from the pan, to the liquid, to the food. Shallow poaching is best suited for boneless, naturally tender, single serving size, sliced or diced pieces of meat, poultry or fish.

This preparation involves smearing the inside of the pan with whole butter and adding aromatics into the pan. The items to be cooked are then placed on top of the aromatics presentation side up. Cold poaching liquid is then poured in until the product is partially submerged then heated. The liquid should never be allowed to boil but kept as close to boiling as possible.

A more contemporary technique of shallow poaching involves BPA free plastic bags and is very convenient for the home cook.

Deep poaching

This technique is similar to shallow poaching but the product is fully submerged. The pot used for deep poaching should hold the food, liquid, and aromatics comfortably, with enough room to allow the liquid to expand as it heats. There should also be enough space so that the surface can be skimmed if necessary throughout cooking. A tight-fitting lid may be helpful for bringing the liquid up to temperature.

Poaching liquid

The poaching liquid traditionally uses a court bouillon which consists of an acid (wine, lemon juice) and aromatics (bouquet garni and mirepoix), although any flavorful liquid can be used in poaching. The liquid should ideally be around 160–185 °F (71–85 °C), but when poaching chicken, it is vital that the chicken reach an internal temperature of at least 165 °F (74 °C) in the core, in order to be ingested safely.

A significant amount of flavor is transferred from the food to the cooking liquid. For maximum flavor, the cooking liquid (cuisson) is usually reduced and used as the base for a sauce.

Poached eggs are generally cooked in water and vinegar, fish in white wine, poultry in stock and fruit in red wine.

The liquid used for shallow poaching is typically called a cuisson, and can be reduced and used as a base for the poached item's sauce.

Typical preparation

Poaching allows the proteins to denature without pulling out too much (if any at all) moisture out of the food. For this reason, it is important to keep the heat low and to keep the poaching time to a bare minimum, which will also preserve the flavor of the food.

Typically an egg is poached just to the point where the white is no longer runny and the yolk is beginning to harden around the edges. Some people say creating a whirlpool helps with poaching eggs because it really helps the egg stay together, wrapping the white around the yolk.

Comparison to other methods of preparation

Water is a relatively efficient conductor of heat, but it also has a fairly low limit to its maximum potential temperature (212 °F (100 °C) at sea level). As such, it is a technique that applies itself to a broad spectrum of methods and results. It is used to regulate food at a low temperature for extended periods, as with sous-vide. It is also used to rapidly raise the temperature of foods, as with blanching.

Poaching itself is part of a family of moist-heat cooking methods but separates itself in that it is primarily for delicate foods such as eggs. Simmering generally uses a higher temperature for cooking, and because it surrounds the food in water that maintains a more or less constant temperature, simmering cooks food very evenly. Boiling uses the absolute highest temperature for water and is least likely to be used in cooking delicate foods.

While it cannot achieve caramelization, which to many is very desirable, many find the delicate nuance of so-called "blanc" foods very pleasant. Poaching is often confused with stewing, as both techniques involve cooking through simmering. However, the purpose of poaching is to cook while retaining the basic shape and structure of the food, rather than to soften it, as with stewing

CHECK YOUR PROGRESS

What is poaching?
Which types of variations are seen in poaching techniques?
Why is it important to keep the heat and poaching time minimum?

3.09 POEING

According to smartkitchen.com, Poêling is a specialized variant of French Roasting, where the food to be cooked is placed in a closed container and is Basted with Whole Butter (sometimes including Herbs and Vegetable flavors).

Let us study basting in more details.

Basting is a cooking technique that involves cooking meat with either its own juices or some type of preparation such as a sauce or marinade. The meat is left to cook, then periodically coated with the juice.

Prominently used in grilling, rotisserie, roasting, and other meat preparations where the meat is over heat for extended periods of time, basting is used to keep meat moist during the cooking process and also to apply or enhance flavor. Improperly administered basting, however, may actually lead to the very problem it is designed to prevent: the undesired loss of moisture (drying out) of the meat.

If not compensated by countermeasures, the opening of the oven door and the resulting loss of temperature and moisture content of the air circulating inside can lead to increased evaporation from the meat surfaces.

To prevent this, the easiest solution is to place the meat in a closed oven bag, which traps evaporating moisture and does not let it disseminate into the oven space and then out to the kitchen. The meat is "auto basted" when the air trapped inside the bag reaches the point of its maximum possible moisture content, and the resulting precipitate forms into drops on the surfaces of the meat or the wall of the bag. The drops roll down to the lowest point of the closed space, where the meat sits and cooks in the resulting juices. This technique often requires minimal or no added liquids other than what the meat already contains, for loss of moisture is virtually negligible from inside the bag. Perhaps even better, some oven pans are designed to carry a lid. Other alternatives include allowing extended cooking time, administering increased amounts of juices, coating the meat with moisture rich fruits or fat-rich cuts, such as bacon, or actual fat, place moisture rich fruits and vegetables around the cooking meats, and if possible, using a convection oven.

Fig 1.20: Basting a turkey with a turkey baster

This is a type of cooking usually recommended for dishes that generally taste mild, but are served with sauces that provide complementing or overpowering flavor to them, for example Chicken chasseur.

Basting is a technique generally known to be used for turkey, pork, chicken, duck, and beef (including steak), but may be applied to virtually any type of meat.

CHECK YOUR PROGRESS

What is Poêling?
What is basting?
What are similarities between Poêling and roasting?

3.10 ROASTING

Roasting is a cooking method that uses dry heat where hot air envelops the food, cooking it evenly on all sides with temperatures of at least 150 °C (~300 °F) from an open flame, oven, or other heat source. Roasting can enhance flavor through caramelization and Maillard browning on the surface of the food. Roasting uses indirect, diffused heat (as in an oven), and is suitable for slower cooking of meat in a larger, whole piece. Meats and most root and bulb vegetables can be roasted. Any piece of meat, especially red meat, that has been cooked in this fashion is called a roast. A roast joint of meat can take one, two, even three hours to cook—the resulting meat is tender. Also, meats and vegetables prepared in this way are described as "roasted", e.g., roasted chicken or roasted squash.

Fig 1.21: A Sunday roast consisting of roast beef, roast potatoes, vegetables, and Yorkshire pudding

Methods

For roasting, the food may be placed on a rack, in a roasting pan or, to ensure even application of heat, may be rotated on a spit or rotisserie. If a pan is used, the juice can be retained for use in gravy, Yorkshire pudding, etc. During oven roasting, hot air circulates around the meat, cooking all sides evenly. There are several plans for roasting meat: low-temperature cooking, high-temperature cooking, and a combination of both. Each method can be suitable, depending on the food and the tastes of the people.

Fig 1.22: Whole roast chicken

A low-temperature oven, 95 °C to 160 °C (200 °F to 325 °F), is best when cooking with large cuts of meat, turkey and whole chickens. This is not technically roasting temperature, but it is called slow-roasting. The benefit of slow-roasting an item is less moisture loss and a more tender product. More of the collagen that makes meat tough is dissolved in slow cooking. At true roasting temperatures, 200 °C (400 °F) or more, the water inside the muscle is lost at a high rate.

Cooking at high temperatures is beneficial if the cut is tender enough—as in filet mignon or strip loin—to be finished cooking before the juices escape. A reason for high temperature roasting is to brown the outside of the food, similar to browning food in a pan before pot roasting or stewing it. Fast cooking gives more variety of flavor, because the outside is brown while the center is much less done.

The combination method uses high heat just at either the beginning or the end of the cooking process, with most of the cooking at a low temperature. This method produces the golden-brown texture and crust, but maintains more of the moisture than simply cooking at a high temperature, although the product will not be as moist as low-temperature cooking the whole time. Searing and then turning down to low is also beneficial when a dark crust and caramelized flavor is desired for the finished product.

In general, in either case, the meat is removed from heat before it has finished cooking and left to sit for a few minutes, while the inside cooks further from the residual heat content, known as carry over cooking.

The objective in any case is to retain as much moisture as possible, while providing the texture and color. As meat cooks, the structure and especially the collagen breaks down, allowing juice to come

out of the meat. So meat is juiciest at about medium rare while the juice is coming out. During roasting, meats and vegetables are frequently basted on the surface with butter, lard, or oil to reduce the loss of moisture by evaporation. In recent times, plastic oven bags have become popular for roasts. These cut cooking times and reduce the loss of moisture during roasting, but reduce flavor development from Maillard browning, somewhat more like (boiled or steamed) stew or pot roast. They are particularly popular for turkeys.

Fig 1.23: Shwarma prepared on a rotating spit

Until the late 19th century, roasting by dry heat in an oven was called baking. Roasting originally meant turning meat or a bird on a spit in front of a fire. It is one of the oldest forms of cooking known.

Traditionally recognized roasting methods consist only of baking and cooking over or near an open fire. Grilling is normally not technically a roast, since a grill (gridiron) is used. Barbecuing and Smoking differ from roasting because of the lower temperature and controlled smoke application. Grilling can be considered as a low-fat food preparation, as it allows any fat in the food to drip away.

Meat

Fig 1.24: A 3 kg (6.6 lb) top round roast of beef, tied and ready to be browned and roasted.

Before the invention and widespread use of stoves, food was primarily cooked over open flames from a hearth. To roast meat racks with skewers, or, if accessible, complicated gear arrangements, would be utilized to turn the piece(s). In the past, this method was often associated with the upper class and special occasions rather than customary meal times because it required freshly killed meat and close attention during cooking. It was easy to ruin the meat's taste with a smoky fire or negligence to rotate it at regular intervals. Thus, elite families who were able to afford quality meat, appointed this task to servants or invested in technology like automatic turning devices. With further technological advances, cooking came to accommodate new opportunities. By the 1860s, working families were able to afford low-priced stove models that became sufficiently available. However, the key element of observation during roasting became difficult and dangerous to do with the coal oven. Hence, traditional roasting disappeared as kitchens became no longer equipped for this custom and soon thereafter, "baking" came to be called "roasting".

Roasting can be applied to a wide variety of meat. In general, it works best for cooking whole chickens, turkey, and leaner cuts of lamb, pork, and beef. The aim is to highlight the flavor of the meat itself rather than a sauce or stew, as it is done in braising or other moist-heat methods. Many roasts are tied with string prior to roasting, often using the reef knot or the packer's knot. Tying holds them together during roasting, keeping any stuffing inside, and keeps the roast in a round profile, which promotes even cooking.

Red meats such as beef, lamb, and venison, and certain game birds are often roasted to be "pink" or "rare", meaning that the center of the roast is still red. Roasting is a preferred method of cooking for most poultry, and certain cuts of beef, pork, or lamb. Although there is a growing fashion in some restaurants to serve "rose pork", temperature monitoring of the center of the roast is the only sure way to avoid foodborne disease.

In Britain, Ireland, and Australia a roast of meat may be referred to as a joint, or a leg, if it is a leg.

Vegetables

Some vegetables, such as potatoes, zucchini, pumpkin, turnips, rutabagas, parsnips, cauliflower, asparagus, squash, and peppers lend themselves to roasting as well. Roasted chestnuts are also a popular snack in winter.

Fish

Fig 1.25: Roasting of burbot with scallops (France) to be cooked

It is also possible to roast fish as meat

CHECK YOUR PROGRESS

What is roasting?
How is roasting done?
How do we roast whole chicken or turkey?

3.11 SAUTEING

Sautéing (/ˈsoʊteɪ.ɪŋ/ or US /soʊˈteɪ.ɪŋ/, /sɔːˈteɪ.ɪŋ/; from the French sauté [sote], lit. "jumped, bounced" in reference to tossing while cooking) is a method of cooking food that uses a small amount of oil or fat in a shallow pan over relatively high heat. Ingredients are usually cut into pieces or thinly sliced to facilitate fast cooking. The primary mode of heat transfer during sautéing is conduction between the pan and the food being cooked. Food that is sautéed is browned while preserving its texture, moisture, and flavor. If meat, chicken, or fish is sautéed, the sauté is often finished by deglazing the pan's residue to make a sauce.

Sautéing may be compared with pan frying, in which larger pieces of food (for example, chops or steaks) are cooked quickly in oil or fat, and flipped onto both sides. Some cooks make a distinction between the two based on the depth of the oil used, while others use the terms interchangeably. Sautéing differs from searing in that searing only browns the surface of the food. Certain oils should not be used to sauté due to their low smoke point. Clarified butter, rapeseed oil and sunflower oil are commonly used for sautéing, but most fats will do. Regular butter will produce more flavor but will burn at a lower temperature and more quickly than other fats due to the presence of milk solids, so clarified butter is more fit for this use.

Method

Fig 1.26: Sautéing onions and peppers

In a sauté, all the ingredients are heated at once, and cooked quickly. To facilitate this, the ingredients are rapidly moved around in the pan, either by the use of a utensil, or by repeatedly jerking the pan itself. A sauté pan must be large enough to hold all of the food in one layer, so steam can escape, which keeps the ingredients from stewing and promotes the development of fond. Most pans sold specifically as sauté pans have a wide flat base and low sides, to maximize the surface area available for heating. The low sides allow quick evaporation and escape of steam. While skillets typically have flared or rounded sides, sauté pans typically have straight, vertical sides. This keeps the ingredients from escaping as the pan is jerked or stirred.

Only enough fat to lightly coat the bottom of the pan is needed for sautéing; too much fat will cause the food to fry rather than just to slide, and may interfere with the development of fond. The food is spread across the hot fat in the pan, and left to brown, turning or tossing frequently for even cooking. The sauté technique involves gripping the handle of the sauté pan firmly, and using a sharp elbow motion to rapidly jerk the pan back toward the cook, repeating as necessary to ensure the ingredients have been thoroughly jumped. Tossing or stirring the items in the pan by shaking the pan too often, however, can cause the pan to cool faster and make the sauté take longer.

CHECK YOUR PROGRESS

What is sautéing?
How is sautéing done?
Why is it important to have just enough fat to lightly coat the bottom of pan while sautéing?

3.12 BRAISING

Braising (from the French word, "braiser") is a combination-cooking method that uses both moist and dry heats: typically, the food is first seared at a high temperature, then finished in a covered pot at a

lower temperature while sitting in some (variable) amount of liquid (which may also add flavor). Braising of meat is often referred to as pot roasting, though some authors make a distinction between the two methods, based on whether additional liquid is added.

Method

Braising relies on heat, time, and moisture to break down the tough connective tissue (collagen) that binds together the muscle fibers collectively called meat, making it an ideal way to cook tougher, more affordable cuts. Many classic braised dishes (e.g., coq au vin) are highly evolved methods of cooking tough and otherwise unpalatable foods. Both pressure cooking and slow cooking (e.g., crockpots) are forms of braising.

Techniques

Fig 1.27: Braised pot roast

Most braises follow the same basic steps. The food to be braised (meats, vegetables, mushrooms, etc.) is first pan-seared to brown its surface and enhance its flavor (through the Maillard reaction). If the food will not produce enough liquid of its own, a certain amount of cooking liquid that often includes an acidic element (e.g., tomatoes, beer, balsamic vinegar, wine) is added to the pot, often with stock. A classic braise is done with a relatively whole cut of meat, and the braising liquid will cover two-thirds of the food in the pan. Then, the dish is covered and cooked at a very low simmer, until the meat becomes so tender that it can be "cut" with just the gentlest of pressure from a fork (versus a knife). Often the cooking liquid is finished to create a sauce or gravy, as well.

Fig 1.28: Chinese braised pork belly

Sometimes, foods with high water content (particularly vegetables) can be cooked in their own juices, making the addition of liquid unnecessary.

Fig 1.29: Braised baby artichokes

A successful braise intermingles the flavors of the foods being cooked with those of the cooking liquid. This cooking method dissolves the meat's collagen into gelatin, which can greatly enrich and thicken the liquid. Braising is economical (as it allows the use of tough and inexpensive cuts), and efficient (as it often enables an entire meal to be prepared in a single pot or pan).

Braised foods

Familiar braised dishes include pot roast, Swiss steak, chicken cacciatore, goulash, Carbonade Flamande, coq au vin, sauerbraten, beef bourguignon, beef brisket, and tajines, among others. Braising is also used extensively in the cuisines of Asia, particularly Chinese cuisine and Vietnamese cuisine, where soy sauce (or in Vietnam, soy sauce and fish sauce) is often the braising liquid.

CHECK YOUR PROGRESS

What is braising?
How do we do braising?
What are techniques of braising?

3.13 MICROWAVE COOKING

A microwave oven (commonly referred to as a microwave) is a kitchen appliance that heats and cooks food by exposing it to microwave radiation in the electromagnetic spectrum. This induces polar molecules in the food to rotate and produce thermal energy in a process known as dielectric heating. Microwave ovens heat foods quickly and efficiently because excitation is fairly uniform in the outer 25–38 mm (1–1.5 inches) of a homogeneous, high water content food item; food is more evenly heated throughout (except in heterogeneous, dense objects) than generally occurs in other cooking techniques.

Percy Spencer is generally credited with inventing the modern microwave oven after World War II from radar technology developed during the war. Named the "Radarange", it was first sold in 1946. Raytheon later licensed its patents for a home-use microwave oven that was first introduced by Tappan in 1955, but these units were still too large and expensive for general home use. The countertop microwave oven was first introduced in 1967 by the Amana Corporation, and their use has spread into commercial and residential kitchens around the world.

Fig 1.30: modern microwave oven (2016)

Microwave ovens are popular for reheating previously cooked foods and cooking a variety of foods. They are also useful for rapid heating of otherwise slowly prepared cooking items, such as hot butter, fats, and chocolate. Unlike conventional ovens, microwave ovens usually do not directly brown or caramelize food, since they rarely attain the necessary temperatures to produce Maillard reactions. Exceptions occur in rare cases where the oven is used to heat frying-oil and other very oily items (such as bacon), which attain far higher temperatures than that of boiling water. Microwave ovens have a limited role in professional cooking, because the boiling-range temperatures produced in especially hydrous foods impede flavors produced by the higher temperatures of frying, browning, or baking. However, additional heat sources can be added to microwave ovens, or into combination microwave ovens, to produce these other heating effects, and microwave heating may cut the overall time needed to prepare such dishes. Some modern microwave ovens are part of over-the-range units with built-in extractor hoods.

Principles

A microwave oven heats food by passing microwave radiation through it. Microwaves are a form of non-ionizing electromagnetic radiation with a frequency higher than ordinary radio waves but lower than infrared light. Microwave ovens use frequencies in one of the ISM (industrial, scientific, medical) bands, which are reserved for this use, so they do not interfere with other vital radio services. Consumer ovens usually use 2.45 gigahertz (GHz)—a wavelength of 12.2 centimetres (4.80 in)—while large industrial/commercial ovens often use 915 megahertz (MHz)—32.8 centimetres (12.9 in). Water, fat, and other substances in the food absorb energy from the microwaves in a process called dielectric heating. Many molecules (such as those of water) are electric dipoles, meaning that they have a partial positive charge at one end and a partial negative charge at the other, and therefore rotate as they try to align themselves with the alternating electric field of the microwaves. Rotating molecules hit other molecules and put them into motion, thus dispersing energy. This energy, when dispersed as molecular vibration in solids and liquids (i.e. as both potential energy and kinetic energy of atoms), is heat. Sometimes, microwave heating is explained as a resonance of water molecules, but this is incorrect; such resonances occur only at above 1 terahertz (THz). Rather it is the lag in response of the polar water molecule to the impending electromagnetic wave. This type of dieletric loss mechanism is referred to as dipole interaction.

Microwave heating is more efficient on liquid water than on frozen water, where the movement of molecules is more restricted. Dielectric heating of liquid water is also temperature-dependent: At 0 °C, dielectric loss is greatest at a field frequency of about 10 GHz, and for higher water temperatures at higher field frequencies.

Compared to liquid water, microwave heating is less efficient on fats and sugars (which have a smaller molecular dipole moment). Sugars and triglycerides (fats and oils) absorb microwaves due to the dipole moments of their hydroxyl groups or ester groups. However, due to the lower specific heat capacity of fats and oils and their higher vaporization temperature, they often attain much higher temperatures inside microwave ovens. This can induce temperatures in oil or very fatty foods like bacon far above the boiling point of water, and high enough to induce some browning reactions, much

in the manner of conventional broiling (UK: grilling), braising, or deep fat frying. Foods high in water content and with little oil rarely exceed the boiling temperature of water.

Microwave heating can cause localized thermal runaways in some materials with low thermal conductivity which also have dielectric constants that increase with temperature. An example is glass, which can exhibit thermal runaway in a microwave to the point of melting if preheated. Additionally, microwaves can melt certain types of rocks, producing small quantities of synthetic lava. Some ceramics can also be melted, and may even become clear upon cooling. Thermal runaway is more typical of electrically conductive liquids such as salty water.

A common misconception is that microwave ovens cook food "from the inside out", meaning from the center of the entire mass of food outwards. This idea arises from heating behavior seen if an absorbent layer of water lies beneath a less absorbent drier layer at the surface of a food; in this case, the deposition of heat energy inside a food can exceed that on its surface. This can also occur if the inner layer has a lower heat capacity than the outer layer causing it to reach a higher temperature, or even if the inner layer is more thermally conductive than the outer layer making it feel hotter despite having a lower temperature. In most cases, however, with uniformly structured or reasonably homogenous food item, microwaves are absorbed in the outer layers of the item at a similar level to that of the inner layers. Depending on water content, the depth of initial heat deposition may be several centimetres or more with microwave ovens, in contrast to broiling/grilling (infrared) or convection heating—methods which deposit heat thinly at the food surface. Penetration depth of microwaves is dependent on food composition and the frequency, with lower microwave frequencies (longer wavelengths) penetrating further.

Heating efficiency

A microwave oven converts only part of its electrical input into microwave energy. An average consumer microwave oven consumes 1100 W of electricity in producing 700 W of microwave power , an efficiency of 64%. The other 400 W are dissipated as heat, mostly in the magnetron tube. Such wasted heat, along with heat from the product being microwaved, is exhausted as warm air through cooling vents. Additional power is used to operate the lamps, AC power transformer, magnetron cooling fan, food turntable motor and the control circuits, although the power consumed by the electronic control circuits of a modern microwave oven is negligible (< 1% of the input power) during cooking.

For cooking or reheating small amounts of food, the microwave oven may use less energy than a cook stove. Although microwave ovens are touted as the most efficient appliance, the energy savings are largely due to the reduced heat mass of the food's container. The amount of energy used to heat food is generally small compared to total energy usage in typical residences in the United States

Microwave-safe plastics

Some current plastic containers and food wraps are specifically designed to resist radiation from microwaves. Products may use the term "microwave safe", may carry a microwave symbol (three lines of waves, one above the other) or simply provide instructions for proper microwave use. Any of

these is an indication that a product is suitable for microwaving when used in accordance with the directions provided.

Benefits and safety features

All microwaves use a timer for the cooking time, at the end of cooking time, the oven switches itself off.

Microwave ovens heat food without getting hot themselves. Taking a pot off a stove, unless it is an induction cooktop, leaves a potentially dangerous heating element or trivet that will stay hot for some time. Likewise, when taking a casserole out of a conventional oven, one's arms are exposed to the very hot walls of the oven. A microwave oven does not pose this problem.

Food and cookware taken out of a microwave oven are rarely much hotter than 100 °C (212 °F). Cookware used in a microwave oven is often much cooler than the food because the cookware is transparent to microwaves; the microwaves heat the food directly and the cookware is indirectly heated by the food. Food and cookware from a conventional oven, on the other hand, are the same temperature as the rest of the oven; a typical cooking temperature is 180 °C (356 °F). That means that conventional stoves and ovens can cause more serious burns.

The lower temperature of cooking (the boiling point of water) is a significant safety benefit compared to baking in the oven or frying, because it eliminates the formation of tars and char, which are carcinogenic. Microwave radiation also penetrates deeper than direct heat, so that the food is heated by its own internal water content. In contrast, direct heat can burn the surface while the inside is still cold. Pre-heating the food in a microwave oven before putting it into the grill or pan reduces the time needed to heat up the food and reduces the formation of carcinogenic char. Unlike frying and baking, microwaving does not produce acrylamide in potatoes, however unlike deep-frying, it is of only limited effectiveness in reducing glycoalkaloid (i.e. solanine) levels. Acrylamide has been found in other microwaved products like popcorn.

Heating characteristics

Microwave ovens are frequently used for reheating leftover food, and bacterial contamination may not be repressed if the safe temperature is not reached, resulting in foodborne illness, as with all inadequate reheating methods.

Uneven heating in microwaved food can be partly due to the uneven distribution of microwave energy inside the oven, and partly due to the different rates of energy absorption in different parts of the food. The first problem is reduced by a stirrer, a type of fan that reflects microwave energy to different parts of the oven as it rotates, or by a turntable or carousel that turns the food; turntables, however, may still leave spots, such as the center of the oven, which receive uneven energy distribution. The location of dead spots and hot spots in a microwave can be mapped out by placing a damp piece of thermal paper in the oven. When the water saturated paper is subjected to the microwave radiation it becomes hot enough to cause the dye to be released which will provide a visual representation of the microwaves. If multiple layers of paper are constructed in the oven with a sufficient distance between them a three-dimensional map can be created. Many store receipts are printed on thermal paper which allows this to be easily done at home.

The second problem is due to food composition and geometry, and must be addressed by the cook, by arranging the food so that it absorbs energy evenly, and periodically testing and shielding any parts of the food that overheat. In some materials with low thermal conductivity, where dielectric constant increases with temperature, microwave heating can cause localized thermal runaway. Under certain conditions, glass can exhibit thermal runaway in a microwave to the point of melting.

Due to this phenomenon, microwave ovens set at too-high power levels may even start to cook the edges of frozen food while the inside of the food remains frozen. Another case of uneven heating can be observed in baked goods containing berries. In these items, the berries absorb more energy than the drier surrounding bread and cannot dissipate the heat due to the low thermal conductivity of the bread. Often this results in overheating the berries relative to the rest of the food. "Defrost" oven settings use low power levels designed to allow time for heat to be conducted within frozen foods from areas that absorb heat more readily to those which heat more slowly. In turntable-equipped ovens, more even heating will take place by placing food off-centre on the turntable tray instead of exactly in the centre.

Microwave heating can be deliberately uneven by design. Some microwavable packages (notably pies) may include materials that contain ceramic or aluminium flakes, which are designed to absorb microwaves and heat up, which aids in baking or crust preparation by depositing more energy shallowly in these areas. Such ceramic patches affixed to cardboard are positioned next to the food, and are typically smokey blue or gray in colour, usually making them easily identifiable; the cardboard sleeves included with Hot Pockets, which have a silver surface on the inside, are a good example of such packaging. Microwavable cardboard packaging may also contain overhead ceramic patches which function in the same way. The technical term for such a microwave-absorbing patch is a susceptor.

Effects on food and nutrients

Fig 1.1:Raisins when overcooked in a microwave produce considerable smoke.

Comparative cooking method studies generally find that, if properly used, microwave cooking does not affect the nutrient content of foods to a larger extent than conventional heating, and that there is a tendency towards greater retention of many micronutrients with microwaving, probably due to the reduced preparation time. Microwaving human milk at high temperatures is contraindicated, due to a marked decrease in activity of anti-infective factors.

Any form of cooking will destroy some nutrients in food, but the key variables are how much water is used in the cooking, how long the food is cooked, and at what temperature. Nutrients are primarily lost by leaching into cooking water, which tends to make microwave cooking healthier, given the shorter cooking times it requires. Like other heating methods, microwaving converts vitamin B12 from an active to inactive form; the amount of inactivation depends on the temperature reached, as well as the cooking time. Boiled food reaches a maximum of 100 °C (212 °F) (the boiling point of water), whereas microwaved food can get locally hotter than this, leading to faster breakdown of vitamin B12. The higher rate of loss is partially offset by the shorter cooking times required. A single study indicated that microwaving broccoli loses 74% or more of phenolic compounds (97% of flavonoids), while boiling loses 66% of flavonoids, and high-pressure boiling loses 47%, though the study has been contradicted by other studies. To minimize phenolic losses in potatoes, microwaving should be done at 500W.

Spinach retains nearly all its folate when cooked in a microwave; in comparison, it loses about 77% when boiled, leaching out nutrients. Bacon cooked by microwave has significantly lower levels of carcinogenic nitrosamines than conventionally cooked bacon. Steamed vegetables tend to maintain more nutrients when microwaved than when cooked on a stovetop. Microwave blanching is 3-4 times more effective than boiled water blanching in the retaining of the water-soluble vitamins folic acid, thiamin and riboflavin, with the exception of ascorbic acid, of which 28.8% is lost (vs. 16% with boiled water blanching)

CHECK YOUR PROGRESS

What is a microwave oven?

What are the misconceptions about microwave heating?
What are microwave safe plastic products?

3.14 OVENS

An oven is a thermally insulated chamber used for the heating, baking or drying of a substance, and most commonly used for cooking. Kilns and furnaces are special-purpose ovens, used in pottery and metalworking, respectively.

Types of ovens

Fig 1.00: A wood-fired pizza oven, a type of masonry oven

Fig 1.00: Stove bench in a German farm's living room

Earth oven: An earth oven is a pit dug into the ground and then heated, usually by rocks or smoldering debris. Historically these have been used by many cultures for cooking. Cooking times are usually long, and the process is usually cooking by slow roasting the food. Earth ovens are among the most common things archaeologists look for at an anthropological dig, as they are one of the key indicators of human civilization and static society.

Ceramic oven: The ceramic oven is an oven constructed of clay or any other ceramic material and takes different forms depending on the culture. The Indians refer to it as a tandoor, and use it for cooking. They can be dated back as far as 3,000 BC, and they have been argued to have their origins in the Indus Valley. Brick ovens are also another ceramic type oven. A culture most notable for the

use of brick ovens is Italy and its intimate history with pizza. However, its history also dates further back to Roman times, wherein the brick oven was used not only for commercial use but household use as well.

Gas oven: One of the first recorded uses of a gas stove and oven referenced a dinner party in 1802 hosted by Zachaus Winzler, where all the food was prepared either on a gas stove or in its oven compartment. In 1834, British inventor James Sharp began to commercially produce gas ovens after installing one in his own house. In 1851, the Bower's Registered Gas Stove was displayed at the Great Exhibition. This stove would set the standard and basis for the modern gas oven. Notable improvements to the gas stove since include the addition of the thermostat which assisted in temperature regulation; also an enamel coating was added to the production of gas stoves and ovens in order to help with easier cleaning.

Masonry oven: Masonry ovens consist of a baking chamber made of fireproof brick, concrete, stone, or clay. Though traditionally wood-fired, coal-fired ovens were common in the 19th century. Modern masonry ovens are often fired with natural gas or even electricity, and are closely associated with artisanal bread and pizza. In the past, however, they were also used for any cooking task that required baking.

Microwave oven: An oven that uses micro radiation waves as a source of heat in order to cook food as opposed to a fire source. Conceptualized in 1946, Dr. Percy Spencer allegedly discovered the heating properties of microwaves while studying the magnetron. By 1947, the first commercial microwave was in use in Boston, Mass.

Wall oven: Wall ovens make it easier to work with large roasting pans and Dutch ovens. A width is typically 24, 27, or 30 inches. Mounted at waist or eye level, a wall oven eliminates bending. However, it can be nested under a countertop to save space. A separate wall oven is expensive compared with a range.

Cooking

Fig 1.00: Interior of a modern oven

In cooking, the conventional oven is a kitchen appliance used for roasting and heating. Foods normally cooked in this manner include meat, casseroles and baked goods such as bread, cake and other desserts. In modern times, the oven is used to cook and heat food in many households across the globe.

Modern ovens are typically fueled by either natural gas or electricity, with bottle gas models available but not common. When an oven is contained in a complete stove, the fuel used for the oven may be the same as or different from the fuel used for the burners on top of the stove.

Ovens usually can use a variety of methods to cook. The most common may be to heat the oven from below. This is commonly used for baking and roasting. The oven may also be able to heat from the top to provide broiling (US) or grilling (UK/Commonwealth). In order to provide faster, more-even cooking, a fan oven, which has a fan with a heating element around, that provides the heat. Or a fan-assisted oven that use a small fan to circulate the air in the cooking chamber, can be used. Both also known as convection ovens. An oven may also provide an integrated rotisserie.

Ovens also vary in the way that they are controlled. The simplest ovens (for example, the AGA cooker) may not have any controls at all; the ovens simply run continuously at various temperatures. More conventional ovens have a simple thermostat which turns the oven on and off and selects the temperature at which it will operate. Set to the highest setting, this may also enable the broiler element. A timer may allow the oven to be turned on and off automatically at pre-set times. More sophisticated ovens may have complex, computer-based controls allowing a wide variety of operating modes and special features including the use of a temperature probe to automatically shut the oven off when the food is completely cooked to the desired degree.

Cleaning

Some ovens provide various aids to cleaning. Continuous cleaning ovens have the oven chamber coated with a catalytic surface that helps break down (oxidize) food splatters and spills over time. Self-cleaning ovens use pyrolytic decomposition (extreme heat) to oxidize dirt. Steam ovens may provide a wet-soak cycle to loosen dirt, allowing easier manual removal. In the absence of any special methods, chemical oven cleaners are sometimes used or just scrubbing.

Industrial, scientific, and artisanal use

Fig 1.00: Industrial "Zanolli" double hearth deck oven (left) and "Sveba-Dahlen" rotary rack oven (right) at the Faculty of Food Technology, Latvia University of Agriculture bakery

Outside the culinary world, ovens are used for a number of purposes.

- A furnace can be used either to provide heat to a building or used to melt substances such as glass or metal for further processing. A blast furnace is a particular type of furnace generally associated with metal smelting (particularly steel manufacture) using refined coke or similar hot-burning substance as a fuel, with air pumped in under pressure to increase the temperature of the fire. A blacksmith uses a temporarily blown furnace, the smith's heart to heat iron to a glowing red to yellow temperature.
- A kiln is a high-temperature oven used in wood drying, ceramics and cement manufacturing to convert mineral feedstock (in the form of clay or calcium or aluminum rocks) into a glassier, more solid form. In the case of ceramic kilns, a shaped clay object is the final result, while cement kilns produce a substance called clinker that is crushed to make the final cement product. (Certain types of drying ovens used in food manufacture, especially those used in malting, are also referred to as kilns.)
- An autoclave is an oven-like device with features similar to a pressure cooker that allows the heating of aqueous solutions to higher temperatures than water's boiling point in order to sterilize the contents of the autoclave.
- Industrial ovens are similar to their culinary equivalents and are used for a number of different applications that do not require the high temperatures of a kiln or furnace.

CHECK YOUR PROGRESS

What is an oven?
What are the various types of ovens?
How are the ovens used in cooking?

3.15 GAS COOKING

In cooking, a gas stove is a cooker/stove which uses natural gas, propane, butane, liquefied petroleum gas or other flammable gas as a fuel source. Prior to the advent of gas, cooking stoves relied on solid fuel such as coal or wood. The first gas stoves were developed in the 1820s, and a gas stove factory was established in England in 1836. This new cooking technology had the advantage that it was easily adjustable and could be turned off when not in use. However the gas stove did not become a commercial success until the 1880s, by which time a supply of piped gas was available in large towns in Britain. The stoves became widespread on the European Continent and in the United States in the early 20th century.

Gas stoves became less unwieldy when the oven was integrated into the base and the size was reduced to fit in better with the rest of the kitchen furniture. By the 1910s, producers started to enamel their gas stoves for easier cleaning. Ignition of the gas was originally by match and this was followed by the more convenient pilot light. This had the disadvantage of a continual consumption of gas. The

oven still needed to be lit by match, and accidentally turning on the gas without igniting it could lead to an explosion. To prevent these types of accidents, oven manufacturers developed and installed a safety valve called a flame failure device for gas hobs and ovens. Most modern gas stoves have electronic ignition, automatic timers for the oven and extractor hoods to remove fumes.

Ignition

Gas stoves today use two basic types of ignition sources, standing pilot and electric. A stove with a standing pilot has a small, continuously burning gas flame (called a pilot light) under the cooktop. The flame is between the front and back burners. When the stove is turned on, this flame lights the gas flowing out of the burners. The advantage of the standing pilot system is that it is simple and completely independent of any outside power source. A minor drawback is that the flames continuously consume fuel even when the stove is not in use. Early gas ovens did not have a pilot. One had to light these manually with a match. If one accidentally left the gas on, gas would fill the oven and eventually the room. A small spark, such as an arc from a light switch being turned on, could ignite the gas, triggering a violent explosion. To prevent these types of accidents, oven manufacturers developed and installed a safety valve called a flame failure device for gas hobs and ovens. The safety valve depends on a thermocouple that sends a signal to the valve to stay open. If a draft blows out the flame or it goes out due to loss of gas pressure, the thermocouple cools and signals the valve to close, shutting off the gas supply. In gas ranges that come with a flame failure device, lighting when there's no power can prove to be a bit of a challenge because unless the user is quick at lighting a match and then turning on the gas valve, the flame failure device cuts off the gas supply within seconds if it senses that the burner isn't lit and there's not much of a point trying to light it once it has already cut off the gas supply.

Although most modern gas stoves have electronic ignition, many households have gas cooking ranges and ovens that need to be lit with a flame. Electric ignition stoves use electric sparks to ignite the surface burners. This is the "clicking sound" audible just before the burner actually lights. The sparks are initiated by turning the gas burner knob to a position typically labeled "LITE" or by pressing the 'ignition' button. Once the burner lights, the knob is turned further to modulate the flame size. Auto reignition is an elegant refinement: the user need not know or understand the wait-then-turn sequence. They simply turn the burner knob to the desired flame size and the sparking is turned off automatically when the flame lights. Auto reignition also provides a safety feature: the flame will be automatically reignited if the flame goes out while the gas is still on—for example by a gust of wind. If the power fails, surface burners must be manually match-lit.

Electric ignition for ovens uses a "hot surface" or "glow bar" ignitor. Basically it is a heating element that heats up to gas's ignition temperature. A sensor detects when the glow bar is hot enough and opens the gas valve.

Also stoves with electric ignition must be connected with gas protection mechanisms such as gas control breaker. Because of this many manufacturers supply stoves without electricity plug.

CHECK YOUR PROGRESS

What is a gas stove?
What kind of ignition sources are used in gas stoves?
What is a flame failure device for gas hobs and ovens?

3.16 INDUCTION COOKING

Induction cooking heats a cooking vessel by magnetic induction, instead of by thermal conduction from a flame, or an electrical heating element. Because inductive heating directly heats the vessel, very rapid increases in temperature can be achieved.

In an induction cooker, a coil of copper wire is placed under the cooking pot and an alternating electric current is passed through it. The resulting oscillating magnetic field induces a magnetic flux which repeatedly magnetises the pot, treating it like the lossy magnetic core of a transformer. This produces large eddy currents in the pot, which because of the resistance of the pot, heats it.

For nearly all models of induction cooktops, a cooking vessel must be made of, or contain, a ferromagnetic metal such as cast iron or some stainless steels. However, copper, glass, non magnetic stainless steels, and aluminum vessels can be used if placed on a ferromagnetic disk which functions as a conventional hotplate.

Induction cooking is quite efficient, which means it puts less waste heat into the kitchen, can be quickly turned off, and has safety advantages compared to gas hobs (cooktops). Hobs are also usually easy to clean, because the hob itself does not get very hot.

Cooking properties

Fig 1.00: An induction cooking surface boiling water through several layers of newsprint. The paper is undamaged since heat is produced only in the bottom of the pot

Induction cooking provides faster heating, improved thermal efficiency, and more consistent heating than cooking by thermal conduction, with precise control similar to gas. The induction element has heating performance comparable to a gas burner, but is significantly more energy-efficient. The

surface of the cooker is heated only by the pot and so does not usually reach a hazardous temperature. Because the temperature of the cooking surface matches that of the pot, this permits precise control of the cooking temperature. The control system shuts down the element if a pot is not present or not large enough. Induction cookers are easy to clean because the cooking surface is flat and smooth and does not get hot enough to make spilled food burn and stick.

The unit can detect whether cookware is present by monitoring power delivered. This allows it to keep a pot just simmering, or automatically turn an element off when cookware is removed.

Because the cook top is shallow compared to a gas-fired or electrical coil cooking surface, wheelchair access can be improved; the user's legs can be below the counter height and the user's arms can reach over the top.

Varying the heat

Less sophisticated induction cookers regulate the heat delivered by switching the field on and off relatively slowly; if a pot with a thin bottom is used, the temperature may fluctuate markedly due to the low thermal inertia of the small amount of metal. This does not occur with cookware that has a thicker bottom, or with induction cookers with more fine-grained control. In many cookers, this only occurs on the lower heat setting(s).

Resilience

Induction cookers usually have glass ceramic tops that can be damaged by sufficient impact although they are required to meet minimum specified product safety standards with regard to impact. Aluminum foil can melt onto the top and cause permanent damage or cracking of the top. Surfaces can be scratched by sliding pans across the cooking surface. As with other electric ceramic cooking surfaces, a maximum pan size may be specified by the manufacturer.

Noise

A small amount of noise is generated by an internal cooling fan. Audible noise (a hum or buzz) may be produced by cookware exposed to high magnetic fields, especially at high power if the cookware has loose parts; cookware with welded-in cladding layers and solid riveting is less likely to produce this type of noise. Some users may detect a whistling or whining sound from the cookware or from the powered electronic devices.

Other considerations

Some cooking techniques available when cooking over a flame are not applicable. Persons with implanted cardiac pacemakers or other electronic medical implants are usually instructed to avoid sources of magnetic fields; the medical literature seems to suggest that proximity to induction cooking surfaces is safe, but individuals with such implants should always check first with their cardiologists. Radio receivers near the induction-cooking unit may pick up some electromagnetic interference.

Efficiency

An induction cooker is faster and more energy-efficient than a traditional electric cooking surface. It allows instant control of cooking power similar to gas burners. Other cooking methods that use flames or hot heating elements have a significantly higher loss to the ambient; induction heating directly heats the pot. Because the induction effect does not directly heat the air around the vessel, induction cooking results in further energy efficiencies. Cooling air is blown through the electronics beneath the surface but is only slightly warm.

According to a technical document of 2001 by U.S. Department of Energy (DOE), the efficiency of energy transfer for an induction cooker is 84%, versus 74% for a smooth-top non-induction electrical unit, for an approximate 12% saving in energy for the same amount of heat transfer.

Energy transfer efficiency, as defined by DOE, is the percentage of the energy consumed by a cooker that, at the end of a simulated cooking cycle, appears to having been transferred as heat to a standardized element — an aluminum test block — simulating a real pan. The DOE test cycle starts with both the block and the cooktop at room temperature: 77 °F ± 9 °F (25 °C ± 5 °C). The cooktop is then switched to maximum heating power. When the test block temperature reaches + 144 °F (+80 °C) above the initial room temperature, the cooktop power is immediately reduced at 25% ± 5% of its maximum power. After 15 minutes of operation at this lower power setting, the cooktop is turned off and the energy (heat) in the test block is measured. Efficiency is given by the ratio between energy in the block and input (electric) energy. Such a kind of test, using a combination of two different power levels, was conceived to mimic real life use. Wasted energy terms such as residual unused heat (retained by solid hot-plates, ceramic or coil at the end of the test), and losses from convection and radiation by hot surfaces (including the ones of the block itself) are simply disregarded and don't contribute to efficiency.

DOE efficiency tests, since the block is homogeneous, cannot distinguish between vessel and content. In real use a small fraction of thermal energy is accumulated by the cooking utensil, is left behind when it is removed, and is finally lost when the utensil cools down. This loss, and energy similarly lost in heating up the utensil, is likely to be very significant when heating up small amounts of food in a short time, and for maximum efficiency it is always important to use the optimum size and shape of pan (tall pans can waste heat through the sides). Anyway in most of the normal cooking practice the energy delivered by whichever kind of cooker — being it induction or not — is only partly used to heat the food up to temperature; once that this has occurred all the subsequent energy input is delivered to the air as loss through steam or convection and radiation from the pan sides, so that at this point the efficiency substantially drops to zero. Real life efficiency is therefore very dependent on pan size and design, but low efficiency is sometimes unavoidable and even necessary for the correct execution of recipes such as reduction of a sauce, braising meat, simmering, and so on.

In 2013 and 2014 DOE developed and proposed new test procedures for cooking products to allow direct comparison of efficiency measurements among induction, electric resistance, and gas cooking tops and ranges. The procedures use a new hybrid test block made of aluminum and stainless steel, so it is suitable for tests on induction cookers. The proposed rule lists results of real lab tests conducted with the hybrid block. For comparable (large) cooking elements the following efficiencies were measured with ±0.5% repeatability: 70.7% - 73.6% for induction, 71.9% for electric coil, 43.9% for

gas. Summarizing the results of several tests, DOE affirms that "induction units have an average efficiency of 72.2%, not significantly higher than the 69.9% efficiency of smooth—electric resistance units, or the 71.2% of electric coil units". Moreover, DOE reminds that the 84% induction efficiency, cited in previous Technical Support Documents, was not measured by DOE laboratories but just "referenced from an external test study" performed in 1992.

In addition independent tests conducted by manufacturers, research laboratories and other subjects seem to demonstrate that actual induction cooking efficiencies stays usually between 74% and 77% and reach occasionally 81% (although these tests could follow procedures different from that of DOE). These clues indicate that the 84% induction average efficiency reference value should be taken with caution.

Just for comparison and in agreement with DOE findings, cooking with gas has an average energy efficiency of about 40%. It can be raised only by using special pots with fins whose first design and commercialization came years ago, but that have been recently rediscovered, redesigned in a different way and put again on the market. So for environmental considerations dealing with induction versus gas, a 40% gas efficiency will be used.

When comparing with gas, the relative cost of electrical and gas energy, and the efficiency of the process by which electricity is generated, affect both overall environmental efficiency (as explained in more detail below) and cost to the user.

Environmental impact

Energy efficiency, as defined so far, is the ratio between energy delivered to the food (and pan) and the energy consumed by the cooker. Such energy refers to the "customer side", that is the amount recorded by the energy meter. Hereinafter it will be assumed — despite the controversial figures collected so far — that induction cooking has about 84% energy efficiency at the customer's (electricity) meter, while cooking with gas has an efficiency of about 40% at the customer's (gas) meter. When comparing consumption of energies of different kinds, in this case natural gas and electricity, the correct method indicated by the US Environmental Protection Agency (EPA) is to refer to source (also called primary) energies. They are the energies of the raw fuels that are consumed to produce the energies delivered on site.

The conversion to source energies is done by multiplying site energies by appropriate source-site ratios. Stated in different terms, the overall environmental efficiencies are obtained dividing the normal (on site) efficiency by the corresponding source-site ratio. Unless there are good reasons to use custom source-site ratios (for example for non US residents or on-site solar), EPA states that "it is most equitable to employ national-level ratios". These ratios amount to 3.34 for electricity purchased from the grid, 1.0 for on-site solar, and 1.047 for natural gas. The natural gas figure is slightly greater than 1 and mainly accounts for distribution losses. The energy efficiencies for cooking given above (84% for induction and 40% for gas) are in terms of site energies at the customer's meters. The (US averaged) efficiencies recalculated relative to source fuels energies are hence 25% for induction

cooking surfaces using grid electricity, 84% for induction cooking surfaces used during daylight hours with on-Site Solar, and 38% for gas burners.

Source-site ratios are not formalized yet in Western Europe. A common consensus should arise on unified European ratios in view of the extension of the Energy Label to domestic water heaters. Unofficial figures for European source-site ratios are about 2.2 for electricity, 1.0 for on-site solar, and 1.02 for natural gas, thus giving overall (referred to source energy) efficiencies of 38% and 84% for induction cooking surfaces (depending on source electricity) and 39% for gas burners.

These provisional figures need to be somehow adjusted due to the higher gas burner efficiency, allowed in Europe by a less stringent limit on carbon monoxide emission at the burner. European and US standards differ in test conditions. The US ANSI Z21.1 standard allows a lower concentration of carbon monoxide (0.08%), compared to the European standard EN 30-1-1 which allows 0.2%. The minimum gas burner efficiency required in the EU by EN 30-2-1 is 52%, higher than the average 40% efficiency measured in US by DOE. The difference is mainly due to the less stringent CO emission limit in EU that allows more efficient burners, and also to different ways in which efficiency is measured.

Whenever local electricity emits less than 435 grams of CO2 per kWh, the greenhouse effect of an induction cooker will be lower than that of a gas cooker. This again comes from the relative efficiencies (84% and 40%) of the two surfaces and from the standard 200 (±5) grams CO2 per kWh emission factor for combustion of natural gas at its net (low) calorific value

Ventilation

The lost energy from the gas cooking goes into heating the kitchen, which can make the kitchen very warm, whereas with induction cookers, the losses are much lower. This can affect the amount of ventilation required.

Gas cooking efficiencies may be lower if waste heat generation is taken into account. Especially in restaurants, gas cooking can significantly increase the ambient temperature in localized areas. Not only may extra cooling be required, but zoned venting may be needed to adequately condition hot areas without overcooling other areas. Costs must be considered on an individual situation due to numerous variables in temperature differences, facility layout or openness, and heat generation schedule. Induction cooking using grid electricity may surpass gas efficiencies when waste heat and air comfort are quantified.

In a commercial setting, induction cookers do not require interlocks between the gas and the ventilation, since electricity cannot explode.

Design

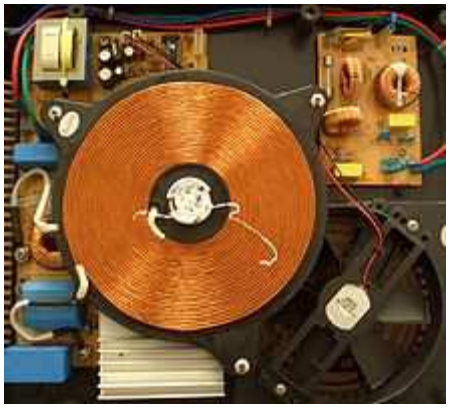


Fig 1.00: Inside view of an induction cooker: the large copper coil forms the magnetic field, a cooling fan is visible below it, and power supply and line filter surround the coil. In the centre of the coil is a temperature sensor, covered in white thermal grease

An induction cooker transfers electrical energy by induction from a coil of wire into a metal vessel that must be ferromagnetic. The coil is mounted under the cooking surface, and a high frequency (e.g. 24 kHz) alternating current is passed through it. The current in the coil creates a dynamic magnetic field. When an electrically conductive pot is brought close to the cooking surface, and the pan is thicker than the skin depth, the magnetic field induces large eddy currents in the pot. The eddy currents flow through the electrical resistance of the pot to produce heat; the pot then in turn heats its contents by heat conduction.

The cooking vessel typically needs to be made of a suitable stainless steel or iron. The increased magnetic permeability of the material decreases the skin depth, concentrating the current near the surface of the metal, and so the electrical resistance will be further increased. Some energy will be dissipated wastefully by the current flowing through the resistance of the coil. To reduce the skin effect and consequent heat generation in the coil, it is made from litz wire, which is a bundle of many smaller insulated wires in parallel. The coil has many turns, while the bottom of the pot effectively forms a single shorted turn. This forms a transformer that steps down the voltage and steps up the current. The resistance of the pot, as viewed from the primary coil, appears larger. In turn, most of the energy becomes heat in the high-resistance steel, while the driving coil stays cool.

Often a thermostat is present to measure the temperature of the pan. This helps prevent the pan from severely overheating if accidentally heated empty or boiled dry, but also can allow the induction cooker to maintain a target temperature.

Applications

Induction equipment may be a built-in surface, part of a range, or a standalone surface unit. Built-in and rangetop units typically have multiple elements, the equivalent of separate burners on a gas-fueled

range. Stand-alone induction modules are usually single-element, or sometimes have dual elements. All such elements share a basic design: an electromagnet sealed beneath a heat-resisting glass-ceramic sheet that is easily cleaned. The pot is placed on the ceramic glass surface and begins to heat up, along with its contents.

In Japan, some models of rice cookers are powered by induction. In Hong Kong, power companies list a number of models. Asian manufacturers have taken the lead in producing inexpensive single-induction-zone surfaces; efficient, low-waste-heat units are advantageous in densely populated cities with little living space per family, as many Asian cities are. Induction cookers are less frequently used in other parts of the world.

Induction ranges may be applicable in commercial restaurant kitchens. Electric cooking avoids the cost of natural gas piping and in some jurisdictions may allow simpler ventilation and fire suppression equipment to be installed. Drawbacks for commercial use include possible breakages of the glass cook-top, higher initial cost and the requirement for magnetic cookware.

Controls

The ferromagnetic properties of a steel vessel concentrate the induced current in a thin layer near its surface, which results in a strong heating effect. In paramagnetic materials like aluminum, the magnetic field penetrates deeper, and the induced current encounters little resistance in the metal. According to Lenz's law the efficiency of the induction in the pot may be sensed, so that the induction may be attained accordingly with special electronics devices. At least one high-frequency "all-metal" cooker is available, that works with lower efficiency on non-ferromagnetic metal cookware.

The cooking surface is made of a glass-ceramic material which is a poor heat conductor, so only a little heat is lost through the bottom of the pot. In normal operation the cooking surface stays significantly cooler than with other hob cooking methods, but still needs to cool down before it can be safely touched.

Units may have one, two, three, four or five induction zones, but four (normally in a 30-inch-wide unit) is the most common in the US and Europe. Two coils are most common in Hong Kong and three are most common in Japan. Some have touch-sensitive controls. Some induction stoves have a memory setting, one per element, to control the time that heat is applied. At least one manufacturer makes a "zoneless" induction cooking surface with multiple induction coils. This allows up to five utensils to be used at once anywhere on the cooking surface, not just on pre-defined zones.

Small stand-alone portable induction cookers are relatively inexpensive, priced from around US$20 in some markets.

Cookware

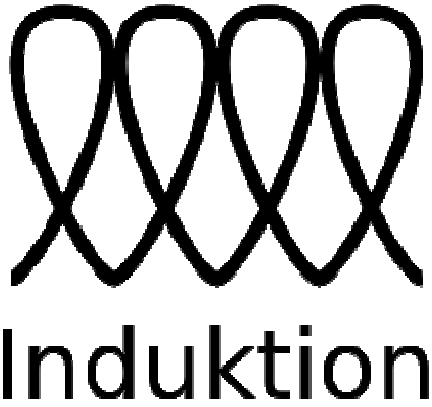


Fig 1.00: Cookware may carry a symbol that identifies it as compatible with an induction cooktop.

Cookware must be compatible with induction heating; in most models, only ferrous metal can be heated. Cookware usually have a flat bottom since the magnetic field drops rapidly with distance from the surface. (Special and costly wok-shaped tops are available for use with round-bottom woks.) Induction disks are metal plates that are heated by induction and heat non-ferrous pots by thermal contact, but these are much less efficient than ferrous cooking vessels.

Induction compatible cookware for an induction cooking surface can nearly always be used on other stoves. Some cookware or packaging is marked with symbols to indicate compatibility with induction, gas, or electric heat. Induction cooking surfaces work well with any pans with a high ferrous metal content at the base. Cast iron pans and any black metal or iron pans will work on an induction cooking surface. Stainless steel pans will work on an induction cooking surface if the base of the pan is a magnetic grade of stainless steel. If a magnet sticks well to the sole of the pan, it will work on an induction cooking surface. An "all-metal" cooker will work with non-ferrous cookware, but available models are limited.

Aluminum or copper alone does not work on an induction stove because of the materials' magnetic and electrical properties. Aluminum and copper cookware are more conductive than steel, but the skin depth in these materials is larger since they are non-magnetic. The current flows in a thicker layer in the metal, encounters less resistance and so produces less heat. The induction cooker will not work efficiently with such pots. However, aluminium and copper are desirable in cookware, since they conduct heat better. Because of this 'tri-ply' pans often have an induction-compatible skin of stainless steel containing a layer of thermally conductive aluminum.

For frying, a pan with a base that is a good heat conductor is needed to spread the heat quickly and evenly. The sole of the pan will be either a steel plate pressed into the aluminum, or a layer of stainless steel over the aluminum. The high thermal conductivity of aluminum pans makes the temperature more uniform across the pan. Stainless frying pans with an aluminum base will not have the same temperature at their sides as an aluminum sided pan will have. Cast iron frying pans work well with induction cooking surfaces but the material is not as good a thermal conductor as aluminum.

When boiling water, the circulating water spreads the heat and prevents hot spots. For products such as sauces, it is important that at least the base of the pan incorporates a good heat conducting material to spread the heat evenly. For delicate products such as thick sauces, a pan with aluminum throughout is better, since the heat flows up the sides through the aluminum, allowing the cook to heat the sauce rapidly but evenly.

Aluminum foil in a square Pyrex dish of water, with a tear where the foil has melted

Fig 1.00: Household foil is much thinner than the skin depth in aluminum at the frequencies used by an induction cooker. Here the foil has melted where it was exposed to the air after steam formed under it. Cooking surface manufacturers prohibit the use of aluminum foil in contact with an induction cooking surface.

The heat that can be produced in a pot is a function of the surface resistance. A higher surface resistance produces more heat for similar currents. This is a "figure of merit" that can be used to rank the suitability of a material for induction heating. The surface resistance in a thick metal conductor is proportional to the resistivity divided by the skin depth. Where the thickness is less than the skin depth, the actual thickness can be used to calculate surface resistance. Some common materials are listed in this table.

Skin depth at 24 kHz					
Material	**Resistivity (10^{-6} ohm-inches)**	**Relative permeability**	**Skin depth, inches (mm)**	**Surface resistance, 10^{-3} ohms/square (thick material)**	**Surface resistance, relative to copper**
Carbon steel 1010	9	200	0.004 (0.10)	2.25	56.25

Skin depth at 24 kHz					
Material	**Resistivity (10^{-6} ohm-inches)**	**Relative permeability**	**Skin depth, inches (mm)**	**Surface resistance, 10^{-3} ohms/square (thick material)**	**Surface resistance, relative to copper**
Stainless steel 432	24.5	200	0.007 (0.18)	3.5	87.5
Stainless steel 304	29	1	0.112 (2.8)	0.26	6.5
Aluminum	1.12	1	0.022 (0.56)	0.051	1.28
Copper	0.68	1	0.017 (0.43)	0.04	1

To get the same surface resistance as with carbon steel would require the metal to be thinner than is practical for a cooking vessel; at 24 kHz a copper vessel bottom would need to be 1/56th the skin depth of carbon steel. Since the skin depth is inversely proportional to the square root of the frequency, this suggests that much higher frequencies (say, several megahertz) would be required to obtain equivalent heating in a copper pot as in an iron pot at 24 kHz. Such high frequencies are not feasible with inexpensive power semiconductors; in 1973 the silicon-controlled rectifiers used were limited to no more than 40 kHz.] Even a thin layer of copper on the bottom of a steel cooking vessel will shield the steel from the magnetic field and make it unusable for an induction top. Some additional heat is created by hysteresis losses in the pot due to its ferromagnetic nature, but this creates less than ten percent of the total heat generated.

"All-metal" models

New types of power semiconductors and low-loss coil designs have made an all-metal cooker possible, but the electronic components are relatively bulky.

Panasonic Corporation in 2009 developed a consumer induction cooker that uses a higher-frequency magnetic field, and a different oscillator circuit design, to allow use with non-ferrous metals.

CHECK YOUR PROGRESS

Describe induction cooking?

What is the difference in the principles used in induction cooking and those in microwave ovens?

What are the advantages of induction cooking?

3.17 END QUESTIONS

1. What is the broad classification of cooking methods? Explain with examples.
2. What is meant by baking? What kind of equipment is required for baking?
3. What is broiling according to Enclyopedia Britannica definition?
4. How do you use a broiler?
5. Describe Grilling.Whar are the health risks in grilling?
6. What are the characteristics of fried food items?
7. What is a stew? Give examples of Indian stews.
8. What are the variations in poaching?
9. Describe roasting. What are the various methods of roasting?
10. What is meant by sautéing?

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UNIT 4: TEA, COFFEE AND CHOCOLATE

4.00 INTROCUTION

In this Unit we will study some of the important food products. We will study tea, coffee, cocoa and chocolate. As you know, tea is the most popular drink after water. There are many medicinal advantages of tea, especially the green tea. The tea is classified according to the degree of oxidation as green, black and other varieties. Tea is grown in India, China, Japan, Srilanka and Taiwan. Tea is made by infusion of plant called Camillia sinensis. Steeping something in hot water causes infusion, whereby juices of the plant leaves get into the hot water.

We will also study coffee, which is next most popular non-alcoholic drink after tea. Cocoa and chocolate are used in various delicacies across the world. The best of cocoa is from Accra in Ghana. We will study chocolate and hot chocolate. Various medicinal properties will also be studied in this unit.

4.01 UNIT OBJECTIVES

After completing this unit you will be able to

- Explain the types of tea
- Elaborate on the process of making tea
- Explain about common tea names by regions
- Describe about coffee and its production
- List various types of coffee
- Elaborate the chocolate
- Explain various delicacies made by chocolate
- Discuss the concept of hot chocolate

4.02 TEA

(Source: Wikipedia)

Tea is an aromatic beverage commonly prepared by pouring hot or boiling water over cured leaves of the *Camellia sinensis*, an evergreen shrub native to Asia. After water, it is the most widely consumed drink in the world. There are many different types of tea; some teas, like Darjeeling and Chinese greens, have a cooling, slightly bitter, and astringent flavor, while others have vastly different profiles that include sweet, nutty, floral or grassy notes.

Tea originated in Southwest China, where it was used as a medicinal drink. It was popularized as a recreational drink during the Chinese Tang dynasty, and tea drinking spread to other East Asian countries. Portuguese priests and merchants introduced it to Europe during the 16th century. During

the 17th century, drinking tea became fashionable among Britons, who started large-scale production and commercialization of the plant in India to bypass the Chinese monopoly.

The phrase herbal tea usually refers to infusions of fruit or herbs made without the tea plant, such as steeps of rosehip, chamomile, or rooibos. These are also known as tisanes or herbal infusions to distinguish them from "tea" as it is commonly understood.

Popular varieties of black tea include Assam, Nepal, Darjeeling, Nilgiri, Turkish, Keemun, and Ceylon teas.

Many of the active substances in black tea do not develop at temperatures lower than 90 °C (194 °F). As a result, black tea in the West is usually steeped in water near its boiling point, at around 99 °C (210 °F). The most common fault when making black tea is to use water at too low a temperature. Since boiling point drops with increasing altitude, it is difficult to brew black tea properly in mountainous areas. Warming the tea pot before steeping is critical at any elevation.

Western black teas are usually brewed for about four minutes and are usually not allowed to steep for less than 30 seconds or more than about five minutes (a process known as brewing or mashing in Britain). In many regions of the world, however, actively boiling water is used and the tea is often stewed. In India, black tea is often boiled for fifteen minutes or longer to make Masala chai, as a strong brew is preferred. Tea should be strained while serving.

Fig 4.01: Teas of different levels of oxidation (L to R): green, yellow, oolong, and black

A food safety management group of the International Organization for Standardization (ISO) has published a standard for preparing a cup of tea (ISO 3103: Tea — Preparation of liquor for use in sensory tests), primarily intended for standardizing preparation for comparison and rating purposes.

Green tea

In regions of the world that prefer mild beverages, such as the West and Far East, green tea should be steeped in water around 80 to 85 °C (176 to 185 °F), the higher the quality of the leaves the lower the temperature. Regions such as North Africa or Central Asia prefer a bitter tea, and hotter water is used. In Morocco, green tea is steeped in boiling water for 15 minutes.

Black tea

The container in which green tea is steeped is often warmed beforehand to prevent premature cooling. High-quality green and white teas can have new water added as many as five or more times, depending on variety, at increasingly higher temperatures.

Flowering tea

Flowering tea or blooming tea should be brewed at 100 °C (212 °F) in clear glass tea wares for up to three minutes. First pull 1/3 water to make the tea ball wet and after 30 seconds add the boiling water up to 4/5 of the capacity of the tea ware. The boiling water can help the tea ball bloom quickly and with a strong aroma of the tea. The height of glass tea ware should be 8–10 cm, which can help the tea and flowers bloom completely. One tea ball can be brewed 4–5 times.

Oolong tea

Sometimes called semi-black, Oolang is popular word in China. It is semi-oxidised leaves of tree plant (Camella Sinensis). Semi-black tea requires a relatively longer infusion time than black tea, and many semi-black tea leaves can be re-used although this is more common in a home situation that in a commercial one. Semi-black teas are also available in bags or in loose leaf form

Oolong tea should be brewed around 82 to 96 °C (185 to 205 °F), with the brewing vessel warmed before pouring the water. Yixing purple clay teapots are the traditional brewing-vessel for oolong tea which can be brewed multiple times from the same leaves, unlike green tea, seeming to improve with reuse. In the Chinese and Taiwanese Gongfu tea ceremony, the first brew is discarded, as it is considered a rinse of leaves rather than a proper brew.

Fig 4.02: Camellia sinensis Kuntze with two species of butterfly by Nicolaas Meerburgh, 1789

Fig 4.03: Masala chai from India with garnishes

Premium or delicate tea

A strainer is often used when tea is made with tea-leaves in a teapot. Some teas, especially green teas and delicate oolong teas, are steeped for shorter periods, sometimes less than 30 seconds. Using a tea strainer separates the leaves from the water at the end of the brewing time if a tea bag is not being used. However, the black Darjeeling tea, a premium Indian tea, needs a longer than average steeping time. Elevation and time of harvest offer varying taste profiles; proper storage and water quality also have a large impact on taste.

Pu-erh tea

Pu-erh teas require boiling water for infusion. Some prefer to quickly rinse pu-erh for several seconds with boiling water to remove tea dust which accumulates from the ageing process, then infuse it at the boiling point (100 °C or 212 °F), and allow it to steep from 30 seconds to five minutes.

Fig 4.04: Oolong tea being infused in a gaiwan

Cold brew and sun tea

While most tea is prepared using hot water, it is also possible to brew a beverage from tea using room temperature or cooled water. This requires longer steeping time to extract the key components, and produces a different flavor profile. For best results, it is best to use about 1.5 times the tea leaves that would be used for hot steeping, and to refrigerate for 4–10 hours. The process of making cold brew tea is much simpler than that for cold brew coffee.

Fig 4.05: Iced Tea

Cold brewing has some disadvantages compared to hot steeping. Firstly, if the leaves or source water contain unwanted bacteria, they may flourish, whereas using hot water has the benefit of killing most bacteria. This is less of a concern in modern times and developed regions. Secondly, cold brewing may allow for less caffeine to be extracted, which may or may not be desired.

Sun tea is made by steeping the tea leaves in a jar of unheated tap water left in the sun. It does not get hot enough to kill bacteria present on the tea leaves or in the water, such as Alcaligenes viscolactis.

Serving

To preserve the pretannin tea without requiring it all to be poured into cups, a second teapot may be used. The steeping pot is best unglazed earthenware; Yixing pots are the best known of these, famed for the high-quality clay from which they are made. The serving pot is generally porcelain, which retains the heat better. Larger teapots are a post-19th century invention, as tea before this time was very rare and very expensive. Experienced tea-drinkers often insist the tea should not be stirred around while it is steeping (sometimes called winding or mashing in the UK). This, they say, will do little to strengthen the tea, but is likely to bring the tannins out in the same way that brewing too long will do. For the same reason, one should not squeeze the last drops out of a teabag; if stronger tea is desired, more tea leaves should be used.

CHECK YOUR PROGRESS

What are the types of tea accroring to the degree of oxidation?
How is the tea served?
What is the oolong tea?

4.03 COFFEE

Coffee is a brewed drink prepared from roasted coffee beans, which are the seeds of berries from the Coffea plant. The genus Coffea is native to tropical Africa, and Madagascar, the Comoros, Mauritius and Réunion in the Indian Ocean. The plant was exported from Africa to countries around the world and coffee plants are now cultivated in over 70 countries, primarily in the equatorial regions of the Americas, Southeast Asia, India, and Africa. The two most commonly grown are the highly regarded arabica, and the less sophisticated but stronger and more hardy robusta. Once ripe, coffee berries are picked, processed, and dried. Dried coffee seeds (referred to as beans) are roasted to varying degrees, depending on the desired flavor. Roasted beans are ground and brewed with near boiling water to produce coffee as a beverage.

Coffee is slightly acidic and can have a stimulating effect on humans because of its caffeine content. Coffee is one of the most popular drinks in the world. It can be prepared and presented in a variety of ways (e.g., espresso, French press, cafe latte, etc.). It is usually served hot, although iced coffee is also served. Clinical studies indicate that moderate coffee consumption is benign or mildly beneficial in healthy adults, with continuing research on whether long-term consumption inhibits cognitive decline during aging or lowers the risk of some forms of cancer.

The earliest credible evidence of coffee-drinking appears in the middle of the 15th century in the Sufi shrines of Yemen. It was here in Arabia that coffee seeds were first roasted and brewed in a similar way to how it is now prepared. Coffee seeds were first exported from East Africa to Yemen, as the coffea arabica plant is thought to have been indigenous to the former. Yemeni traders took coffee back to their homeland and began to cultivate the seed. By the 16th century, it had reached Persia, Turkey, and North Africa. From there, it spread to Europe and the rest of the world.

Coffee is a major export commodity: it is the top agricultural export for numerous countries and is among the world's largest legal agricultural exports. It is one of the most valuable commodities exported by developing countries. Green (unroasted) coffee is one of the most traded agricultural commodities in the world. Some controversy is associated with coffee cultivation and the way developed countries trade with developing nations and the impact of its cultivation on the environment, in regards to clearing of land for coffee-growing and water use. Consequently, the markets for fair trade coffee and organic coffee are expanding.

Fig 4.06: Coffee plant

Processing

Coffee berries and their seeds undergo several processes before they become the familiar roasted coffee. Berries have been traditionally selectively picked by hand; a labor-intensive method, it involves the selection of only the berries at the peak of ripeness. More commonly, crops are strip picked, where all berries are harvested simultaneously regardless of ripeness by person or machine. After picking, green coffee is processed by one of two methods—the dry process method, simpler and less labor-intensive as the berries can be strip picked, and the wet process method, which incorporates fermentation into the process and yields a mild coffee.

Fig 4.07:Traditional coffee beans drying in Kalibaru, Indonesia

Then they are sorted by ripeness and color and most often the flesh of the berry is removed, usually by machine, and the seeds are fermented to remove the slimy layer of mucilage still present on the seed. When the fermentation is finished, the seeds are washed with large quantities of fresh water to remove the fermentation residue, which generates massive amounts of coffee wastewater. Finally, the seeds are dried.

The best (but least used) method of drying coffee is using drying tables. In this method, the pulped and fermented coffee is spread thinly on raised beds, which allows the air to pass on all sides of the coffee, and then the coffee is mixed by hand. In this method the drying that takes place is more uniform, and fermentation is less likely. Most African coffee is dried in this manner and certain coffee farms around the world are starting to use this traditional method.

Next, the coffee is sorted, and labeled as green coffee. Another way to let the coffee seeds dry is to let them sit on a concrete patio and rake over them in the sunlight. Some companies use cylinders to pump in heated air to dry the coffee seeds, though this is generally in places where the humidity is very high.

An Asian coffee known as kopi luwak undergoes a peculiar process made from coffee berries eaten by the Asian palm civet, passing through its digestive tract, with the beans eventually harvested from feces. Coffee brewed from this process is among the most expensive in the world, with bean prices

reaching $160 per pound or $30 per brewed cup. Kopi luwak coffee is said to have uniquely rich, slightly smoky aroma and flavor with hints of chocolate, resulting from the action of digestive enzymes breaking down bean proteins to facilitate partial fermentation.

Roasting

The next step in the process is the roasting of the green coffee. Coffee is usually sold in a roasted state, and with rare exceptions all coffee is roasted before it is consumed. It can be sold roasted by the supplier, or it can be home roasted. The roasting process influences the taste of the beverage by changing the coffee bean both physically and chemically. The bean decreases in weight as moisture is lost and increases in volume, causing it to become less dense. The density of the bean also influences the strength of the coffee and requirements for packaging.

The actual roasting begins when the temperature inside the bean reaches approximately 200 °C (392 °F), though different varieties of seeds differ in moisture and density and therefore roast at different rates. During roasting, caramelization occurs as intense heat breaks down starches, changing them to simple sugars that begin to brown, which alters the color of the bean.

Sucrose is rapidly lost during the roasting process, and may disappear entirely in darker roasts. During roasting, aromatic oils and acids weaken, changing the flavor; at 205 °C (401 °F), other oils start to develop. One of these oils, caffeol, is created at about 200 °C (392 °F), which is largely responsible for coffee's aroma and flavor.

Roasting is the last step of processing the beans in their intact state. During this last treatment, while still in the bean state, more caffeine breaks down above 235 °C (455 °F). Dark roasting is the utmost step in bean processing removing the most caffeine. Although, dark roasting is not to be confused with the Decaffeination process.

Grading roasted beans

Depending on the color of the roasted beans as perceived by the human eye, they will be labeled as light, medium light, medium, medium dark, dark, or very dark. A more accurate method of discerning the degree of roast involves measuring the reflected light from roasted seeds illuminated with a light source in the near-infrared spectrum. This elaborate light meter uses a process known as spectroscopy to return a number that consistently indicates the roasted coffee's relative degree of roast or flavor development

Fig 4.08: Coffee "cuppers", or professional tasters, grade the coffee

Roast characteristics

The degree of roast has an effect upon coffee flavor and body. Darker roasts are generally bolder because they have less fiber content and a more sugary flavor. Lighter roasts have a more complex and therefore perceived stronger flavor from aromatic oils and acids otherwise destroyed by longer roasting times. Roasting does not alter the amount of caffeine in the bean, but does give less caffeine when the beans are measured by volume because the beans expand during roasting.

A small amount of chaff is produced during roasting from the skin left on the seed after processing. Chaff is usually removed from the seeds by air movement, though a small amount is added to dark roast coffees to soak up oils on the seeds.

Decaffeination

Decaffeination may also be part of the processing that coffee seeds undergo. Seeds are decaffeinated when they are still green. Many methods can remove caffeine from coffee, but all involve either soaking the green seeds in hot water (often called the "Swiss water process") or steaming them, then using a solvent to dissolve caffeine-containing oils. Decaffeination is often done by processing companies, and the extracted caffeine is usually sold to the pharmaceutical industry.

Storage

Coffee is best stored in an airtight container made of ceramic, glass, or non-reactive metal. Higher quality prepackaged coffee usually has a one-way valve which prevents air from entering while allowing the coffee to release gases. Coffee freshness and flavor is preserved when it is stored away from moisture, heat, and light. The ability of coffee to absorb strong smells from food means that it

should be kept away from such smells. Storage of coffee in the refrigerator is not recommended due to the presence of moisture which can cause deterioration. Exterior walls of buildings which face the sun may heat the interior of a home, and this heat may damage coffee stored near such a wall. Heat from nearby ovens also harms stored coffee.

In 1931, a method of packing coffee in a sealed vacuum in cans was introduced. The roasted coffee was packed and then 99% of the air was removed, allowing the coffee to be stored indefinitely until the can was opened. Today this method is in mass use for coffee in a large part of the world.

Brewing

Fig 4.09: a contemporary automatic coffeemaker

Coffee beans must be ground and brewed to create a beverage. The criteria for choosing a method include flavor and economy. Almost all methods of preparing coffee require that the beans be ground and then mixed with hot water long enough to allow the flavor to emerge but not so long as to draw out bitter compounds. The liquid can be consumed after the spent grounds are removed. Brewing considerations include the fineness of grind, the way in which the water is used to extract the flavor, the ratio of coffee grounds to water (the brew ratio), additional flavorings such as sugar, milk, and spices, and the technique to be used to separate spent grounds. Ideal holding temperatures range from 85–88 °C (185–190 °F) to as high as 93 °C (199 °F) and the ideal serving temperature is 68 to 79 °C (154 to 174 °F). The recommended brew ratio for non-espresso coffee is around 55 to 60 grams of grounds per litre of water, or two level tablespoons for a 5- or 6-ounce cup.

The roasted coffee beans may be ground at a roastery, in a grocery store, or in the home. Most coffee is roasted and ground at a roastery and sold in packaged form, though roasted coffee beans can be ground at home immediately before consumption. It is also possible, though uncommon, to roast raw beans at home.

The choice of brewing method depends to some extent on the degree to which the coffee beans have been roasted. Lighter roasted coffee tends to be used for filter coffee as the combination of method and roast style results in higher acidity, complexity, and clearer nuances. Darker roasted coffee is used

for espresso because the machine naturally extracts more dissolved solids, causing lighter coffee to become too acidic.

Coffee beans may be ground in several ways. A burr grinder uses revolving elements to shear the seed; a blade grinder cuts the seeds with blades moving at high speed; and a mortar and pestle crushes the seeds. For most brewing methods a burr grinder is deemed superior because the grind is more even and the grind size can be adjusted.

The type of grind is often named after the brewing method for which it is generally used. Turkish grind is the finest grind, while coffee percolator or French press are the coarsest grinds. The most common grinds are between these two extremes: a medium grind is used in most home coffee-brewing machines.

Coffee may be brewed by several methods. It may be boiled, steeped, or pressurized. Brewing coffee by boiling was the earliest method, and Turkish coffee is an example of this method. It is prepared by grinding or pounding the seeds to a fine powder, then adding it to water and bringing it to the boil for no more than an instant in a pot called a cezve or, in Greek, a bríki. This produces a strong coffee with a layer of foam on the surface and sediment (which is not meant for drinking) settling at the bottom of the cup.

Coffee percolators and automatic coffeemakers brew coffee using gravity. In an automatic coffeemaker, hot water drips onto coffee grounds that are held in a paper, plastic, or perforated metal coffee filter, allowing the water to seep through the ground coffee while extracting its oils and essences. The liquid drips through the coffee and the filter into a carafe or pot, and the spent grounds are retained in the filter.

In a percolator, boiling water is forced into a chamber above a filter by steam pressure created by boiling. The water then seeps through the grounds, and the process is repeated until terminated by removing from the heat, by an internal timer, or by a thermostat that turns off the heater when the entire pot reaches a certain temperature.

Coffee may be brewed by steeping in a device such as a French press (also known as a cafetière, coffee press or coffee plunger). Ground coffee and hot water are combined in a cylindrical vessel and left to brew for a few minutes. A circular filter which fits tightly in the cylinder fixed to a plunger is then pushed down from the top to force the grounds to the bottom. The filter retains the grounds at the bottom as the coffee is poured from the container. Because the coffee grounds are in direct contact with the water, all the coffee oils remain in the liquid, making it a stronger beverage. This method of brewing leaves more sediment than in coffee made by an automatic coffee machine. Supporters of the French press method point out that the sediment issue can be minimized by using the right type of grinder: they claim that a rotary blade grinder cuts the coffee bean into a wide range of sizes, including a fine coffee dust that remains as sludge at the bottom of the cup, while a burr grinder uniformly grinds the beans into consistently-sized grinds, allowing the coffee to settle uniformly and be trapped by the press. Within the first minute of brewing 95% of the caffeine is released from the coffee bean.

The espresso method forces hot pressurized and vaporized water through ground coffee. As a result of brewing under high pressure (ideally between 9–10 atm), the espresso beverage is more concentrated (as much as 10 to 15 times the quantity of coffee to water as gravity-brewing methods can produce) and has a more complex physical and chemical constitution. A well-prepared espresso has a reddish-brown foam called crema that floats on the surface. Other pressurized water methods include the moka pot and vacuum coffee maker.

Cold brew coffee is made by steeping coarsely ground beans in cold water for several hours, then filtering them. This results in a brew lower in acidity than most hot-brewing methods.

Nutrition

Brewed coffee from typical grounds prepared with tap water contains 40 mg caffeine per 100 gram and no essential nutrients in significant content. In espresso, however, likely due to its higher amount of suspended solids, there are significant contents of magnesium, the B vitamins, niacin and riboflavin, and 212 mg of caffeine per 100 grams of grounds.

Serving

Once brewed, coffee may be served in a variety of ways. Drip-brewed, percolated, or French-pressed/cafetière coffee may be served as white coffee with a dairy product such as milk or cream, or dairy substitute, or as black coffee with no such addition. It may be sweetened with sugar or artificial sweetener. When served cold, it is called iced coffee.

Espresso-based coffee has a variety of possible presentations. In its most basic form, an espresso is served alone as a shot or short black, or with hot water added, when it is known as Caffè Americano. A long black is made by pouring a double espresso into an equal portion of water, retaining the crema, unlike Caffè Americano. Milk is added in various forms to an espresso: steamed milk makes a caffè latte, equal parts steamed milk and milk froth make a cappuccino, and a dollop of hot foamed milk on top creates a caffè macchiato. A flat white is prepared by adding steamed hot milk (microfoam) to espresso so that the flavour is brought out and the texture is unusually velvety. It has less milk than a latte but both are varieties of coffee to which the milk can be added in such a way as to create a decorative surface pattern. Such effects are known as latte art.

Coffee can also be incorporated with alcohol to produce a variety of beverages: it is combined with whiskey in Irish coffee, and it forms the base of alcoholic coffee liqueurs such as Kahlúa and Tia Maria. Darker beers such as stout and porter give a chocolate or coffee-like taste due to roasted grains even though actual coffee beans are not added to it.

Instant coffee

Fig 4.10: Instant coffee

A number of products are sold for the convenience of consumers who do not want to prepare their own coffee or who do not have access to coffeemaking equipment. Instant coffee is dried into soluble powder or freeze-dried into granules that can be quickly dissolved in hot water. Originally invented in 1907, it rapidly gained in popularity in many countries in the post-war period, with Nescafé being the most popular product. Many consumers determined that the convenience in preparing a cup of instant coffee more than made up for a perceived inferior taste, although, since the late 1970s, instant coffee has been produced differently in such a way that is similar to the taste of freshly brewed coffee. Paralleling (and complementing) the rapid rise of instant coffee was the coffee vending machine invented in 1947 and widely distributed since the 1950s.

Canned coffee has been popular in Asian countries for many years, particularly in China, Japan, South Korea, and Taiwan. Vending machines typically sell varieties of flavored canned coffee, much like brewed or percolated coffee, available both hot and cold. Japanese convenience stores and groceries also have a wide availability of bottled coffee drinks, which are typically lightly sweetened and pre-blended with milk. Bottled coffee drinks are also consumed in the United States.

Liquid coffee concentrates are sometimes used in large institutional situations where coffee needs to be produced for thousands of people at the same time. It is described as having a flavor about as good as low-grade robusta coffee, and costs about 10¢ a cup to produce. The machines can process up to 500 cups an hour, or 1,000 if the water is preheated.

CHECK YOUR PROGRESS

What is coffee?
How is coffee processed?
What is instant coffee??

4.04 HOT CHOCOLATE

Fig 4.11: Hot Chocolate

Hot chocolate, also known as **hot cocoa**, **drinking chocolate** or just **cocoa** is a heated beverage consisting of shaved chocolate, melted chocolate or cocoa powder, heated milk or water, and usually a sweetener. Hot chocolate may be topped with whipped cream. Hot chocolate made with melted chocolate is sometimes called drinking chocolate, characterized by less sweetness and a thicker consistency.

The first chocolate beverage is believed to have been created by the Maya around 2,500-3,000 years ago, and a cocoa beverage was an essential part of Aztec culture by 1400 AD. The beverage became popular in Europe after being introduced from Mexico in the New World and has undergone multiple changes since then. Until the 19th century, hot chocolate was even used medicinally to treat ailments such as liver and stomach diseases.

In the 2010s, hot chocolate is consumed throughout the world and comes in multiple variations, including the spiced *chocolate para mesa* of Latin America, the very thick *cioccolata calda* served in Italy and *chocolate a la taza* served in Spain, and the thinner hot cocoa consumed in the United States. Prepared hot chocolate can be purchased from a range of establishments, including cafeterias,

fast food restaurants, coffeehouses and cafes. Powdered hot chocolate mixes, which can be added to boiling water or hot milk to make the drink at home, are sold at grocery stores.

Historical Background

Archaeologists have found evidence that Mayan chocolate consumption occurred as early as 500 BC, and there is speculation that chocolate predates even the Mayans. To make the chocolate drink, which was served cold, the Maya ground cocoa seeds into a paste and mixed it with water, cornmeal, chili peppers, and other ingredients. They then poured the drink back and forth from a cup to a pot until a thick foam developed. Chocolate was available to Maya of all social classes, although the wealthy drank chocolate from "large spouted vessels" that were often buried with elites. An early Classic period (460-480 AD) Mayan tomb from the site of Rio Azul, Guatemala, had vessels with the Maya glyph for cacao on them with residue of a chocolate drink.

Because sugar was yet to come to the Americas, xocolatl was said to be an acquired taste. What the Spaniards then called xocolatl was said to be a beverage consisting of a chocolate base flavored with vanilla and other spices that was served cold. The drink tasted spicy and bitter as opposed to sweetened modern hot chocolate. As to when xocolatl was first served hot, sources conflict on when and by whom. However, Jose de Acosta, a Spanish Jesuit missionary who lived in Peru and then Mexico in the later 16th century, described xocolatl as:

Loathsome to such as are not acquainted with it, having a scum or froth that is very unpleasant taste. Yet it is a drink very much esteemed among the Indians, where with they feast noble men who pass through their country. The Spaniards, both men and women, that are accustomed to the country, are very greedy of this Chocolate. They say they make diverse sorts of it, some hot, some cold, and some temperate, and put therein much of that "chili"; yea, they make paste thereof, the which they say is good for the stomach and against the catarrh.

Terminology

A distinction is sometimes made between "hot cocoa", made from powder made by removing most of the rich cocoa butter from the ground cacao beans, and "hot chocolate", made directly from bar chocolate, which already contains cocoa, sugar, and cocoa butter. Thus, the major difference between the two is the cocoa butter, the absence of which makes hot cocoa significantly lower in fat than hot chocolate while still preserving all the antioxidants found in chocolate.

Hot chocolate can be made with dark, semisweet, or bittersweet chocolate chopped into small pieces and stirred into milk with the addition of sugar. American instant hot cocoa powder often includes powdered milk or other dairy ingredients so it can be made without using milk. In the United Kingdom, "hot chocolate" is a sweet chocolate drink made with hot milk or water, and powder containing chocolate, sugar, and powdered milk. "Cocoa" usually refers to a similar drink made with just hot milk and cocoa powder, then sweetened to taste with sugar (or not sweetened at all).

Usage

Today, hot chocolate in the form of drinking chocolate or cocoa is considered a comfort food and is widely consumed in many parts of the world. European hot chocolate tends to be relatively thick and

rich, while in the United States the thinner instant version is consumed more often. In Nigeria hot chocolate is referred to as "tea" even though it is not actually a tea due to the Nigerian custom of referring to drinks consumed in the morning as "tea". Many regions have distinctive additives or toppings, ranging from marshmallow and whipped cream to cheese.

Fig 4.12: A woman (Aline Masson) drinking a cup of chocolate, in a canvas by Raimundo Madrazo

Europe

Fig 4.13: Hot chocolate is called warme chocolademelk in the Netherlands.

Fig 4.14: Hot chocolate in Melbourne, Australia

In mainland Europe (particularly Spain and Italy), hot chocolate is sometimes served very thick due to the use of a thickening agent such as cornstarch. Among the multiple thick forms of hot chocolate served in Europe is the Italian cioccolata calda.

Hot chocolate with churros is the traditional working-man's breakfast in Spain. This style of hot chocolate can be extremely thick, often having the consistency of warm chocolate pudding. In the Netherlands, hot chocolate is a very popular drink, known as chocolademelk, it is often served at home or in cafes. In France, hot chocolate is often served at breakfast time; sometimes sliced bread spread with butter, jam, honey, or Nutella is dunked into the hot chocolate.

In Germany, hot chocolate made by melted chocolate (Heiße Schokolade Wiener Art) is distinguished from those made from powders (Trinkschokolade). It is often served with whipped cream on top.

Even further variations of hot chocolate exist. In some cafes in Belgium and other areas in Europe, one who orders a "warme chocolade" or "chocolat chaud" receives a cup of steaming white milk and a small bowl of bittersweet chocolate chips to dissolve in the milk. One Viennese variant Heiße Schokolade Wiener Art contains an egg yolk for thickness.

North America

In the United States, the drink is popular in instant form, made with hot water or milk from a packet containing mostly cocoa powder, sugar, and dry milk. This is the thinner of the two main variations. It is very sweet and may be topped with marshmallows, whipped cream, or a piece of solid chocolate. Hot chocolate was first brought to North America as early as the 17th century by the Dutch, but the first time colonists began selling hot chocolate was around 1755. Traditionally, hot chocolate has been associated with cold weather, winter, and dessert in the United States.

In Mexico, hot chocolate remains a popular national drink, often including semi-sweet chocolate, cinnamon, sugar, and vanilla. Hot chocolate of this type is commonly sold in circular or hexagonal tablets which can be dissolved into hot milk, water, or cream, and then blended until the mixture develops a creamy froth. A 1942 article in the Chicago Tribune describes Mexican cinnamon hot chocolate as being traditionally served alongside a variety of sweet Mexican pastries, such as pan dulce or churros.

Fig 4.15: Traditional Spanish hot chocolate served with churros

South America

In Colombia, a hot chocolate beverage made with milk and water using a chocolatera and molinillo is enjoyed as part of breakfast with bread and soft, fresh farmer's cheese. Colombian hot chocolate is often topped with a soft farmer's cheese or other mild cheese. Similarly, hot chocolate in Ecuador is often topped with cheese.

In Peru, hot chocolate can be served with panettone at breakfast on Christmas Day, even though summer has already started in the southern hemisphere. In addition, many Peruvians will add a sweet chocolate syrup to their drink. The Argentinian submarino is a hot chocolate drink made from adding a chocolate bar and sugar to hot steamed milk.

Health

Nutritional value per 100 g		
Energy	322.168 kJ (77.000 kcal)	
Carbohydrates	10.74 g	
Sugars	9.66 g	
Dietary fiber	1 g	
Fat	2.34 g	
Saturated	1.431 g	
Trans	0.078 g	
Monounsaturated	0.677 g	
Polyunsaturated	0.084 g	
Protein	3.52 g	
Vitamins		
Vitamin A equiv.	51 µg	(6%)
Vitamin A	176 IU	
Thiamine (B_1)	0.039 mg	(3%)
Riboflavin (B_2)	0.182 mg	(15%)
Niacin (B_3)	0.133 mg	(1%)
Vitamin B_6	0.04 mg	(3%)
Folate (B_9)	5 µg	(1%)
Vitamin B_{12}	0.49 µg	(20%)
Vitamin C	0.2 mg	(0%)
Vitamin D	1.1 µg	(7%)
Vitamin D	45 IU	(8%)
Vitamin E	0.03 mg	(0%)
Vitamin K	0.2 µg	(0%)
Minerals		
Calcium	114 mg	(11%)
Iron	0.42 mg	(3%)
Magnesium	23 mg	(6%)
Phosphorus	105 mg	(15%)
Potassium	197 mg	(4%)
Sodium	44 mg	(3%)
Zinc	0.63 mg	(7%)

Although hot chocolate is generally consumed for pleasure, the beverage confers several potential health benefits. A 2003 study from Cornell University found that cocoa contains large amounts of antioxidants that may help prevent cancer. Also, it has been demonstrated that the cocoa bean helps with digestion. From the 16th to 19th centuries, hot chocolate was valued as a medicine as well as a drink.

The explorer Francisco Hernández wrote that chocolate beverages helped treat fever and liver disease. Another explorer, Santiago de Valverde Turices, believed that large amounts of hot chocolate were helpful in treating chest ailments and that smaller amounts could help stomach disorders. When

chocolate was introduced to the French in the 17th century, it was reportedly used "to fight against fits of anger and bad moods", which may be attributed to chocolate's phenylethylamine content. Today, hot chocolate is consumed for pleasure rather than medicinally, but new research suggests that there may be other health benefits attributed to the drink.

On the other hand, several negative effects can be attributed to drinking hot chocolate, as some hot chocolate recipes contain high amounts of sugar, hydrogenated oils, or fats.

Benefits

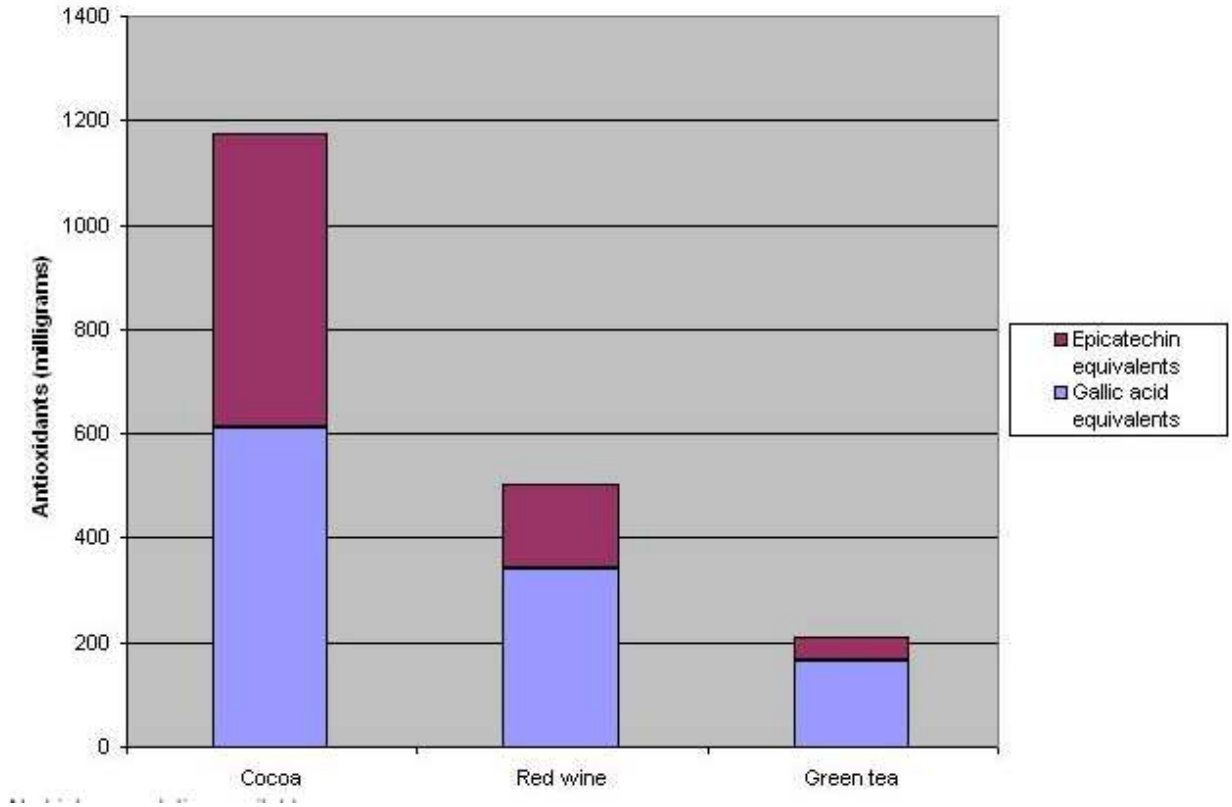

Fig 4.16: A graph showing the amounts of antioxidants contained in cocoa, red wine, and green tea

Research has shown that the consumption of hot chocolate can be positive to one's health. A study conducted by Cornell University has shown that hot chocolate contains more antioxidants than wine and tea, therefore reducing the risk of heart disease. In a single serving of cocoa, the researchers found 611 milligrams of gallic acid equivalents (GAE) and 564 milligrams of epicatechin equivalents (ECE), compared with 340 milligrams of GAE and 163 milligrams of ECE in red wine, and 165 milligrams of GAE and 47 milligrams of ECE in green tea. Chang Yong Lee, the professor and researcher at Cornell who conducted the study, revealed that larger amounts of antioxidants are released when the beverage is heated.

The flavonoids found in the cocoa that makes up hot chocolate also have a positive effect on arterial health. A particular study performed by the National Institutes of Health partially supported by Mars Chocolate company showed high amounts of improvement in blood flow after drinking a flavanol-

rich cocoa beverage. In the study, the subjects (27 people ages 18 to 72) drank a cocoa drink containing 900 milligrams of flavonols every day, which resulted in an improvement in blood flow and the function of endothelial cells that line blood vessels.

In further studies conducted by Dr. Norman K. Hollenberg, professor of medicine at Brigham and Women's Hospital and Harvard Medical School found that flavonols may also help vessels dilate and help keep platelets from clustering on the blood vessel walls. Flavonoids found in hot chocolate are beneficial to health mainly because they shield the walls of blood vessels from free radical damage. Flavanols are also thought to help reduce blood platelet buildup and can balance levels of compounds called eicosanoids, which may be beneficial to cardiovascular health.

Risks

Several negative effects may be attributed to the drinking of hot chocolate. The types and severity of health risks vary between different styles of hot chocolate. Hot chocolate made from milk also contains the sugars naturally found in milk. Processed cocoa powder usually contains additional sugars. Some brands also contain hydrogenated oils and fats, the most common of which are coconut derivatives.

4.05 CHOCOLATE

Chocolate /ˈtʃɒklɪt, -kəlɪt/ is a typically sweet, usually brown food preparation of Theobroma cacao seeds, roasted and ground. It is made in the form of a liquid, paste, or in a block, or used as a flavoring ingredient in other foods. Cacao has been cultivated by many cultures for at least three millennia in Mesoamerica. The earliest evidence of use traces to the Mokaya (Mexico and Guatemala), with evidence of chocolate beverages dating back to 1900 BCE. In fact, the majority of Mesoamerican people made chocolate beverages, including the Maya and Aztecs, who made it into a beverage known as xocolātl Nahuatl pronunciation: [ʃoˈkolaːt͡ɬ], a Nahuatl word meaning "bitter water". The seeds of the cacao tree have an intense bitter taste and must be fermented to develop the flavor.

After fermentation, the beans are dried, cleaned, and roasted. The shell is removed to produce cacao nibs, which are then ground to cocoa mass, unadulterated chocolate in rough form. Once the cocoa mass is liquefied by heating, it is called chocolate liquor. The liquor also may be cooled and processed into its two components: cocoa solids and cocoa butter. Baking chocolate, also called bitter chocolate, contains cocoa solids and cocoa butter in varying proportions, without any added sugars. Much of the chocolate consumed today is in the form of sweet chocolate, a combination of cocoa solids, cocoa butter or added vegetable oils, and sugar. Milk chocolate is sweet chocolate that additionally contains milk powder or condensed milk. White chocolate contains cocoa butter, sugar, and milk, but no cocoa solids.

Fig 4.17: Chocolate most commonly comes in dark, milk, and white varieties, with cocoa solids contributing to the brown color.

Cocoa solids are a source of flavonoids and alkaloids, such as theobromine, phenethylamine and caffeine. Chocolate also contains anandamide.

Chocolate has become one of the most popular food types and flavors in the world, and a vast number of foodstuffs involving chocolate have been created, particularly desserts including cakes, pudding, mousse, chocolate brownies, and chocolate chip cookies. Many candies are filled with or coated with sweetened chocolate, and bars of solid chocolate and candy bars coated in chocolate are eaten as snacks. Gifts of chocolate molded into different shapes (e.g., eggs, hearts) have become traditional on certain Western holidays, such as Easter and Valentine's Day. Chocolate is also used in cold and hot beverages such as chocolate milk and hot chocolate and in some alcoholic drinks, such as creme de cacao.

Fig 4.18: Chocolate cherries

Although cocoa originated in the Americas, recent years have seen African nations assuming a leading role in producing cocoa. Since the 2000s, Western Africa produces almost two-thirds of the world's cocoa, with Ivory Coast growing almost half of that amount.

Types

Several types of chocolate can be distinguished. Pure, unsweetened chocolate, often called "baking chocolate", contains primarily cocoa solids and cocoa butter in varying proportions. Much of the chocolate consumed today is in the form of sweet chocolate, which combines chocolate with sugar.

Milk chocolate is sweet chocolate that also contains milk powder or condensed milk. In the UK and Ireland, milk chocolate must contain a minimum of 20% total dry cocoa solids; in the rest of the European Union, the minimum is 25%. "White chocolate" contains cocoa butter, sugar, and milk, but no cocoa solids. Chocolate contains alkaloids such as theobromine and phenethylamine, which have physiological effects in humans, but the presence of theobromine renders it toxic to some animals, such as dogs and cats. Chocolate contains "brain cannabinoids" such as anandamide, N-oleoylethanolamine and N-linoleoylethanolamine. Dark chocolate has been promoted for unproven health benefits.

White chocolate, although similar in texture to that of milk and dark chocolate, does not contain any cocoa solids. Because of this, many countries do not consider white chocolate as chocolate at all. Because it does not contain any cocoa solids, white chocolate does not contain any theobromine, so it can be consumed by animals.

Fig 4.19: Disk of chocolate (about 4cm in diameter), as sold in Central America, for making hot cocoa. Note that the chocolate pictured here is soft, can easily be crumbled by hand, and already has sugar added.

Dark chocolate is produced by adding fat and sugar to the cacao mixture. The U.S. Food and Drug Administration calls this "sweet chocolate", and requires a 15% concentration of chocolate liquor. European rules specify a minimum of 35% cocoa solids. Semisweet chocolate is a dark chocolate with a low sugar content. Bittersweet chocolate is chocolate liquor to which some sugar (typically a third), more cocoa butter, vanilla, and sometimes lecithin have been added. It has less sugar and more liquor than semisweet chocolate, but the two are interchangeable in baking.

Unsweetened chocolate is pure chocolate liquor, also known as bitter or baking chocolate. It is unadulterated chocolate: the pure, ground, roasted chocolate beans impart a strong, deep chocolate flavor. It is typically used in baking or other products to which sugar and other ingredients are added. Raw chocolate, often referred to as raw cacao, is always dark and a minimum of 75% cacao.

Poorly tempered chocolate may have whitish spots on the dark chocolate part, called chocolate bloom; it is an indication that sugar and/or fat has separated due to poor storage. It is not toxic and can be safely consumed.

Production

Fig 4.20: Chocolate is created from the cocoa bean. A cacao tree with fruit pods in various stages of ripening

Roughly two-thirds of the entire world's cocoa is produced in West Africa, with 43% sourced from Ivory Coast, where child labor is a common practice to obtain the product. According to the World Cocoa Foundation, some 50 million people around the world depend on cocoa as a source of livelihood. In the UK, most chocolatiers purchase their chocolate from them, to melt, mold and package to their own design. According to the WCF's 2012 report, the Ivory Coast is the largest producer of cocoa in the world.

Production costs can be decreased by reducing cocoa solids content or by substituting cocoa butter with another fat. Cocoa growers object to allowing the resulting food to be called "chocolate", due to the risk of lower demand for their crops. The sequencing in 2010 of the genome of the cacao tree may allow yields to be improved.

The two main jobs associated with creating chocolate candy are chocolate makers and chocolatiers. Chocolate makers use harvested cacao beans and other ingredients to produce couverture chocolate (covering). Chocolatiers use the finished couverture to make chocolate candies (bars, truffles, etc.).

Cacao varieties

Fig 4.21: Toasted cacao beans at a chocolate workshop at the La Chonita Hacienda in Tabasco

Chocolate is made from cocoa beans, the dried and fermented seeds of the cacao tree (Theobroma cacao), a small, 4–8 m tall (15–26 ft tall) evergreen tree native to the deep tropical region of the Americas. Recent genetic studies suggest the most common genotype of the plant originated in the Amazon basin and was gradually transported by humans throughout South and Central America. Early forms of another genotype have also been found in what is now Venezuela. The scientific name, Theobroma, means "food of the deities". The fruit, called a cacao pod, is ovoid, 15–30 cm (6–12 in) long and 8–10 cm (3–4 in) wide, ripening yellow to orange, and weighing about 500 g (1.1 lb) when ripe.

Cacao trees are small, understory trees that need rich, well-drained soils. They naturally grow within 20° of either side of the equator because they need about 2000 mm of rainfall a year, and temperatures in the range of 21 to 32 °C (70 to 90 °F). Cacao trees cannot tolerate a temperature lower than 15 °C (59 °F).

The three main varieties of cacao beans used in chocolate are criollo, forastero, and trinitario.

Criollo

Representing only 5% of all cocoa beans grown, criollo is the rarest and most expensive cocoa on the market, and is native to Central America, the Caribbean islands and the northern tier of South American states. The genetic purity of cocoas sold today as criollo is disputed, as most populations have been exposed to the genetic influence of other varieties.

Criollos are particularly difficult to grow, as they are vulnerable to a variety of environmental threats and produce low yields of cocoa per tree. The flavor of criollo is described as delicate yet complex, low in classic chocolate flavor, but rich in "secondary" notes of long duration.

Forastero

The most commonly grown bean is forastero, a large group of wild and cultivated cacaos, most likely native to the Amazon basin. The African cocoa crop is entirely of the forastero variety. They are significantly hardier and of higher yield than criollo. The source of most chocolate marketed, forastero cocoas are typically strong in classic "chocolate" flavor, but have a short duration and are unsupported by secondary flavors, producing "quite bland" chocolate.

Trinitario

Trinitario is a natural hybrid of criollo and forastero. Trinitario originated in Trinidad after an introduction of forastero to the local criollo crop. Nearly all cacao produced over the past five decades is of the forastero or lower-grade trinitario varieties.

Processing

Cacao pods are harvested by cutting them from the tree using a machete, or by knocking them off the tree using a stick. The beans with their surrounding pulp are removed from the pods and placed in piles or bins, allowing access to micro-organisms so fermentation of the pectin-containing material can begin. Yeasts produce ethanol, lactic acid bacteria produce lactic acid, and acetic acid bacteria produce acetic acid. The fermentation process, which takes up to seven days, also produces several flavor precursors, eventually resulting in the familiar chocolate taste.

Fig 4.22: "dancing the cocoa", El Cidros, Trinidad, c. 1957

It is important to harvest the pods when they are fully ripe, because if the pod is unripe, the beans will have a low cocoa butter content, or sugars in the white pulp will be insufficient for fermentation, resulting in a weak flavor. After fermentation, the beans must be quickly dried to prevent mold growth. Climate and weather permitting, this is done by spreading the beans out in the sun from five to seven days.

The dried beans are then transported to a chocolate manufacturing facility. The beans are cleaned (removing twigs, stones, and other debris), roasted, and graded. Next, the shell of each bean is removed to extract the nib. Finally, the nibs are ground and liquefied, resulting in pure chocolate in

fluid form: chocolate liquor. The liquor can be further processed into two components: cocoa solids and cocoa butter.

Blending

Fig 4.23 Fountain chocolate is made with high levels of cocoa butter, allowing it to flow gently over a chocolate fountain to serve as dessert fondue.

Chocolate liquor is blended with the cocoa butter in varying quantities to make different types of chocolate or couvertures. The basic blends of ingredients for the various types of chocolate (in order of highest quantity of cocoa liquor first), are:

- Dark chocolate: sugar, cocoa butter, cocoa liquor, and (sometimes) vanilla
- Milk chocolate: sugar, cocoa butter, cocoa liquor, milk or milk powder, and vanilla
- White chocolate: sugar, cocoa butter, milk or milk powder, and vanilla

Usually, an emulsifying agent, such as soy lecithin, is added, though a few manufacturers prefer to exclude this ingredient for purity reasons and to remain GMO-free, sometimes at the cost of a perfectly smooth texture. Some manufacturers are now using PGPR, an artificial emulsifier derived from castor oil that allows them to reduce the amount of cocoa butter while maintaining the same mouthfeel.

The texture is also heavily influenced by processing, specifically conching (see below). The more expensive chocolate tends to be processed longer and thus have a smoother texture and mouthfeel, regardless of whether emulsifying agents are added.

Different manufacturers develop their own "signature" blends based on the above formulas, but varying proportions of the different constituents are used. The finest, plain dark chocolate couvertures contain at least 70% cocoa (both solids and butter), whereas milk chocolate usually contains up to 50%. High-quality white chocolate couvertures contain only about 35% cocoa butter.

Producers of high-quality, small-batch chocolate argue that mass production produces bad-quality chocolate. Some mass-produced chocolate contains much less cocoa (as low as 7% in many cases), and fats other than cocoa butter. Vegetable oils and artificial vanilla flavor are often used in cheaper chocolate to mask poorly fermented and/or roasted beans.

In 2007, the Chocolate Manufacturers Association in the United States, whose members include Hershey, Nestlé, and Archer Daniels Midland, lobbied the Food and Drug Administration (FDA) to change the legal definition of chocolate to let them substitute partially hydrogenated vegetable oils for cocoa butter, in addition to using artificial sweeteners and milk substitutes. Currently, the FDA does not allow a product to be referred to as "chocolate" if the product contains any of these ingredients.

In the EU a product can be sold as chocolate if it contains up to 5% vegetable oil, and must be labelled as "family milk chocolate" rather than "milk chocolate" if it contains 20% milk.

According to Canadian Food and Drug Regulations, a "chocolate product" is a food product that is sourced from at least one "cocoa product" and contains at least one of the following: "chocolate, bittersweet chocolate, semi-sweet chocolate, dark chocolate, sweet chocolate, milk chocolate, or white chocolate." A "cocoa product" is defined as a food product that is sourced from cocoa beans and contains "cocoa nibs, cocoa liquor, cocoa mass, unsweetened chocolate, bitter chocolate, chocolate liquor, cocoa, low-fat cocoa, cocoa powder, or low-fat cocoa powder."

Conching

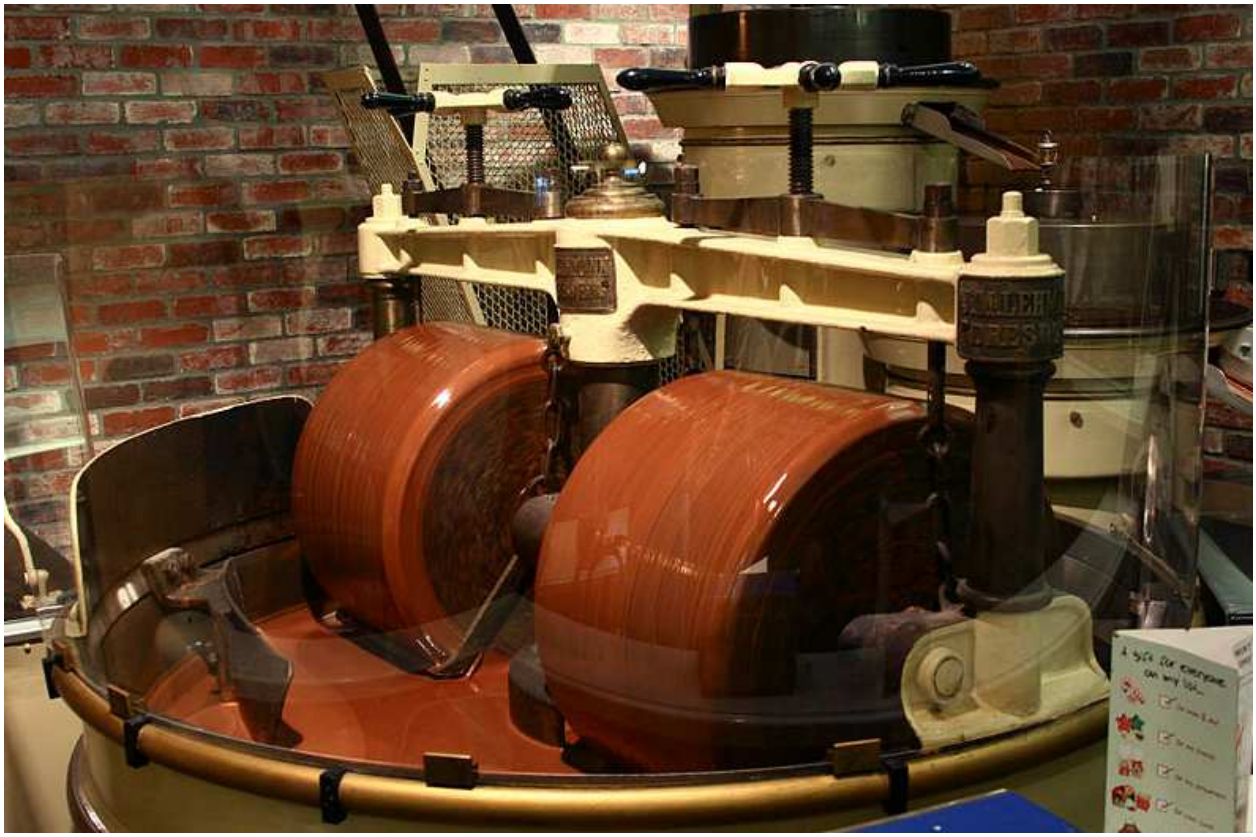

Fig 4.24: Chocolate melanger mixing raw ingredients

The penultimate process is called conching. A conche is a container filled with metal beads, which act as grinders. The refined and blended chocolate mass is kept in a liquid state by frictional heat. Chocolate prior to conching has an uneven and gritty texture. The conching process produces cocoa and sugar particles smaller than the tongue can detect, hence the smooth feel in the mouth. The length of the conching process determines the final smoothness and quality of the chocolate. High-quality chocolate is conched for about 72 hours, and lesser grades about four to six hours. After the process is complete, the chocolate mass is stored in tanks heated to about 45 to 50 °C (113 to 122 °F) until final processing.

Tempering

The final process is called tempering. Uncontrolled crystallization of cocoa butter typically results in crystals of varying size, some or all large enough to be clearly seen with the naked eye. This causes the surface of the chocolate to appear mottled and matte, and causes the chocolate to crumble rather than snap when broken. The uniform sheen and crisp bite of properly processed chocolate are the result of consistently small cocoa butter crystals produced by the tempering process.

The fats in cocoa butter can crystallize in six different forms (polymorphous crystallization). The primary purpose of tempering is to assure that only the best form is present. The six different crystal forms have different properties.

Crystal	Melting temp.	Notes
I	17 °C (63 °F)	Soft, crumbly, melts too easily
II	21 °C (70 °F)	Soft, crumbly, melts too easily
III	26 °C (79 °F)	Firm, poor snap, melts too easily
IV	28 °C (82 °F)	Firm, good snap, melts too easily
V	34 °C (93 °F)	Glossy, firm, best snap, melts near body temperature (37 °C)
VI	36 °C (97 °F)	Hard, takes weeks to form

Fig 4.25: Molten chocolate and a piece of a chocolate bar

As a solid piece of chocolate, the cocoa butter fat particles are in a crystalline rigid structure that gives the chocolate its solid appearance. Once heated, the crystals of the polymorphic cocoa butter are able to break apart from the rigid structure and allow the chocolate to obtain a more fluid consistency as the temperature increases – the melting process. When the heat is removed, the cocoa butter crystals become rigid again and come closer together, allowing the chocolate to solidify.

The temperature in which the crystals obtain enough energy to break apart from their rigid conformation would depend on the milk fat content in the chocolate and the shape of the fat molecules, as well as the form of the cocoa butter fat. Chocolate with a higher fat content will melt at a lower temperature.

Making chocolate considered "good" is about forming as many type V crystals as possible. This provides the best appearance and texture and creates the most stable crystals, so the texture and appearance will not degrade over time. To accomplish this, the temperature is carefully manipulated during the crystallization.

Generally, the chocolate is first heated to 45 °C (113 °F) to melt all six forms of crystals. Next, the chocolate is cooled to about 27 °C (81 °F), which will allow crystal types IV and V to form. At this temperature, the chocolate is agitated to create many small crystal "seeds" which will serve as nuclei to create small crystals in the chocolate. The chocolate is then heated to about 31 °C (88 °F) to eliminate any type IV crystals, leaving just type V. After this point, any excessive heating of the chocolate will destroy the temper and this process will have to be repeated. However, other methods of chocolate tempering are used. The most common variant is introducing already tempered, solid "seed" chocolate. The temper of chocolate can be measured with a chocolate temper meter to ensure accuracy and consistency. A sample cup is filled with the chocolate and placed in the unit which then displays or prints the results.

Two classic ways of manually tempering chocolate are:

- Working the molten chocolate on a heat-absorbing surface, such as a stone slab, until thickening indicates the presence of sufficient crystal "seeds"; the chocolate is then gently warmed to working temperature.
- Stirring solid chocolate into molten chocolate to "inoculate" the liquid chocolate with crystals (this method uses the already formed crystals of the solid chocolate to "seed" the molten chocolate).

Chocolate tempering machines (or temperers) with computer controls can be used for producing consistently tempered chocolate. In particular continuous tempering machines are used in large volume applications. Various methods and apparatuses for continuous flow tempering have been described by Aasted, Sollich and Buhler, three manufacturers of commercial chocolate equipment, with a focus now on energy efficiency. In general, molten chocolate coming in at 40–50 °C is cooled in heat exchangers to crystallization temperates of about 26–30 °C, passed through a tempering column consisting of spinning plates to induce shear, then warmed slightly to re-melt undesirable crystal formations.

Storage

Fig 4.26: Packaged chocolate in the Ghirardelli Chocolate Company is stored in controlled conditions.

Chocolate is very sensitive to temperature and humidity. Ideal storage temperatures are between 15 and 17 °C (59 and 63 °F), with a relative humidity of less than 50%. Various types of "blooming" effects can occur if chocolate is stored or served improperly. Fat bloom is caused by storage temperature fluctuating or exceeding 24 °C (75 °F), while sugar bloom is caused by temperature below 15 °C (59 °F) or excess humidity. To distinguish between different types of bloom, one can rub the surface of the chocolate lightly, and if the bloom disappears, it is fat bloom. One can get rid of bloom by retempering the chocolate or using it for any use that requires melting the chocolate.

Chocolate is generally stored away from other foods, as it can absorb different aromas. Ideally, chocolates are packed or wrapped, and placed in proper storage with the correct humidity and temperature. Additionally, chocolate is frequently stored in a dark place or protected from light by wrapping paper.

If refrigerated or frozen without containment, chocolate can absorb enough moisture to cause a whitish discoloration, the result of fat or sugar crystals rising to the surface. Moving chocolate from one temperature extreme to another, such as from a refrigerator on a hot day, can result in an oily texture. Although visually unappealing, chocolate suffering from bloom is perfectly safe for consumption.

Nutrition and research

Candies, milk chocolate

Nutritional value per 100 g (3.5 oz)		
Energy	2,240 kJ (540 kcal)	
Carbohydrates	59.4	
Sugars	51.5	
Dietary fiber	3.4 g	
Fat	29.7	
Protein	7.6	
Vitamins		
Vitamin A	195 IU	
Thiamine (B_1)	0.1 mg	(9%)
Riboflavin (B_2)	0.3 mg	(25%)
Niacin (B_3)	0.4 mg	(3%)
Vitamin B_6	0.0 mg	(0%)
Folate (B_9)	11 µg	(3%)
Vitamin B_{12}	0.7 µg	(29%)
Choline	46.1 mg	(9%)
Vitamin C	0 mg	(0%)
Vitamin E	0.5 mg	(3%)
Vitamin K	5.7 µg	(5%)
Minerals		
Calcium	189 mg	(19%)
Iron	2.4 mg	(18%)
Magnesium	63 mg	(18%)
Manganese	0.5 mg	(24%)
Phosphorus	208 mg	(30%)
Potassium	372 mg	(8%)
Selenium	4.5 µg	(6%)
Sodium	79 mg	(5%)
Zinc	2.3 mg	(24%)

Nutrition

A 100 gram serving of milk chocolate supplies 540 calories. It is 59% carbohydrates (52% as sugar and 3% as dietary fiber), 30% fat and 8% protein (table). Approximately 65% of the fat in milk

chocolate is saturated, composed mainly of palmitic acid and stearic acid, while the predominant unsaturated fat is oleic acid (table, see USDA reference for full report).

In 100 gram amounts, milk chocolate is an excellent source (> 19% of the Daily Value, DV) of riboflavin, vitamin B12 and the dietary minerals, manganese, phosphorus and zinc (table). Chocolate is a good source (10–19% DV) of calcium, magnesium and iron (table).

Effects on health

Chocolate may be a factor for heartburn in some people because one of its constituents, theobromine, may affect the oesophageal sphincter muscle, hence permitting stomach acidic contents to enter into the oesophagus. Theobromine is also toxic to some animals unable to metabolize it (see theobromine poisoning).

Excessive consumption of large quantities of any energy-rich food, such as chocolate, without a corresponding increase in activity to expend the associated calories, can increase the risk of weight gain and possibly obesity. Raw chocolate is high in cocoa butter, a fat which is removed during chocolate refining, then added back in varying proportions during the manufacturing process. Manufacturers may add other fats, sugars, and milk as well, all of which increase the caloric content of chocolate.

Chocolate and cocoa contain moderate to high amounts of oxalate, which may increase risk for kidney stones. During cultivation and production, chocolate may absorb lead from the environment, but the total amounts typically eaten are less than the tolerable daily limit for lead consumption, according to a World Health Organization report from 2010. However, reports from 2014 indicate that "chocolate might be a significant source" of lead ingestion for children if consumption is high and "one 10 g cube of dark chocolate may contain as much as 20% of the daily lead oral limit."

A few studies have documented allergic reactions from chocolate in children.

Research

Chocolate and cocoa are under preliminary research to determine if consumption affects the risk of certain cardiovascular diseases or cognitive abilities.

Labeling

Some manufacturers provide the percentage of chocolate in a finished chocolate confection as a label quoting percentage of "cocoa" or "cacao". It should be noted that this refers to the combined percentage of both cocoa solids and cocoa butter in the bar, not just the percentage of cocoa solids. The Belgian AMBAO certification mark indicates that no non-cocoa vegetable fats have been used in making the chocolate.

Chocolates that are organic or fair trade certified carry labels accordingly.

In the United States, some large chocolate manufacturers lobbied the federal government to permit confections containing cheaper hydrogenated vegetable oil in place of cocoa butter to be sold as "chocolate". In June 2007, as a response to consumer concern after the proposed change, the FDA

reiterated "Cacao fat, as one of the signature characteristics of the product, will remain a principal component of standardized chocolate."

Industry

The chocolate industry is a steadily growing, $50 billion-a-year worldwide business centered on the sale and consumption of chocolate. It is prevalent throughout most of the world. Europe accounts for 45% of the world's chocolate revenue and the US$20 billion. Big Chocolate is the grouping of major international chocolate companies in Europe and the U.S. The U.S. companies, such as Mars and Hershey's alone, generate $13 billion a year in chocolate sales and account for two-thirds of U.S. production. Despite the expanding reach of the chocolate industry internationally, cocoa farmers and labourers in the Ivory Coast are unaware of the uses of the beans. The high cost of chocolate in the Ivory Coast also means that it is inaccessible to the majority of the population, who are unaware of what it tastes like.

Manufacturers

Fig 4.27: Chocolate with various fillings.

Chocolate manufacturers produce a range of products from chocolate bars to fudge. Large manufacturers of chocolate products include Cadbury (the world's largest confectionery

manufacturer), Ferrero, Guylian, The Hershey Company, Lindt & Sprüngli, Mars, Incorporated, Milka, Neuhaus and Suchard.

Guylian is best known for its chocolate sea shells; Cadbury for its Dairy Milk and Creme Egg. The Hershey Company, the largest chocolate manufacturer in North America, produces the Hershey Bar and Hershey's Kisses. Mars Incorporated, a large privately owned U.S. corporation, produces Mars Bar, Milky Way, M&M's, Twix, and Snickers. Lindt is known for its truffle balls and gold foil-wrapped Easter bunnies.

Food conglomerates Nestlé SA and Kraft Foods both have chocolate brands. Nestlé acquired Rowntree's in 1988 and now markets chocolates under their own brand, including Smarties (a chocolate candy) and Kit Kat (a candy bar); Kraft Foods through its 1990 acquisition of Jacobs Suchard, now owns Milka and Suchard. In February 2010, Kraft also acquired British-based Cadbury.; Fry's, Trebor Basset and the fair trade brand Green & Black's also belongs to the group.

Human trafficking of child labourers

The widespread use of children in cocoa production is controversial, not only for the concerns about child labor and exploitation, but also because up to 12,000 of the 200,000 children working in Côte d'Ivoire, the world's biggest producer of cocoa, may be victims of trafficking or slavery. Most attention on this subject has focused on West Africa, which collectively supplies 69 percent of the world's cocoa, and Côte d'Ivoire in particular, which supplies 35 percent of the world's cocoa. Thirty percent of children under age 15 in sub-Saharan Africa are child laborers, mostly in agricultural activities including cocoa farming. It is estimated that more than 1.8 million children in West Africa are involved in growing cocoa. Major chocolate producers, such as Nestlé, buy cocoa at commodities exchanges where Ivorian cocoa is mixed with other cocoa.

In 2009, Salvation Army International Development (SAID) UK stated that 12,000 children have been trafficked on cocoa farms in the Ivory Coast of Africa, where half of the world's chocolate is made. SAID UK states that it is these child slaves who are likely to be working in "harsh and abusive" conditions for the production of chocolate, and an increasing number of health-food and anti-slavery organisations are now highlighting and campaigning against the use of trafficking in the chocolate industry.

Fair trade

In the 2000s, some chocolate producers began to engage in fair trade initiatives, to address concerns about the marginalization of cocoa laborers in developing countries. Traditionally, Africa and other developing countries received low prices for their exported commodities such as cocoa, which caused poverty to abound. Fair trade seeks to establish a system of direct trade from developing countries to counteract this unfair system. One solution for fair labor practices is for farmers to become part of an Agricultural cooperative. Cooperatives pay farmers a fair price for their cocoa so farmers have enough money for food, clothes, and school fees. One of the main tenets of fair trade is that farmers receive a fair price, but this does not mean that the larger amount of money paid for fair trade cocoa goes directly to the farmers. The effectiveness of fair trade has been questioned. In a 2014 article, The

Economist stated that workers on fair trade farms have a lower standard of living than on similar farms outside the fair trade system.

Usage and consumption

Fig 4.28: A chocolate cake with chocolate frosting.

Chocolate is sold in chocolate bars, which come in dark chocolate, milk chocolate and white chocolate varieties. Some bars that are mostly chocolate have other ingredients blended into the chocolate, such as nuts, raisins or crisped rice. Chocolate is used as an ingredient in a huge variety of candy bars, which typically contain various confectionary ingredients (e.g., nougat, wafers, caramel, nuts, etc.) which are coated in chocolate. Chocolate is used as a flavouring product in many desserts, such as chocolate cakes, chocolate brownies, chocolate mousse and chocolate chip cookies. Numerous types of candy and snacks contain chocolate, either as a filling (e.g., M&M's) or as a coating (e.g., chocolate-coated raisins or chocolate-coated peanuts). Some non-alcoholic beverages contain chocolate, such as chocolate milk, hot chocolate and chocolate milkshakes. Some alcoholic liqueurs are flavoured with chocolate, such as chocolate liqueur and creme de cacao. Chocolate is a popular flavour of ice cream and pudding, and chocolate sauce is a commonly added as a topping on ice cream sundaes.

4.06 END QUESTIONS

1. Explain the various types of tea
2. Describe various types of coffee
3. Explain what equipments are used in preparing and serving tea
4. Explain what equipments are used in preparing and serving coffee
5. Describe how tea is prepared and served using tea bag
6. Describe how tea pot is prepared and served
7. Describe how iced tea is prepared and served
8. Explain the health benefits of chocolate
9. Explain how chocolate is processed.
10. Describe the size of chocolate industry.

4.07 REFERENCES AND FURTHER READING

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