Yashwantrao Chavan
Maharashtra Open University

V101:B. Sc. (Hospitality and Tourism Studies)
V102: B.Sc. (Hospitality Studies & Catering Services)
HTS 201: Food Production Foundation - II

YASHWANTRAO CHAVAN MAHARASHTRA OPEN UNIVERSITY

HTS 201: Food Production Foundation –II

V101: B. Sc. Hospitality and Tourism Studies
(2016 Pattern)

V102: B. Sc. Hospitality Studies and Catering Services
(2016 Pattern)

Developed by Dr Rajendra Vadnere, Director, School of Continuing Education, YCMOU

HTS201: Food Production Foundation –II

(Theory: 4 Credits; Total Hours =60, Practical: 2 Credits, Total Hours =60)

Unit – 1 Methods of Cooking: - Introduction, Definition, and its importance; Types- Baking, Broiling, Grilling, Frying, Steaming, Stewing, Poaching, Poeling, Roasting, Frying, Sautéing, Braising Cooking with Microwave, Ovens, Gas, Induction Plates and other such media. HACCP Standards and Professional Kitchens.

Unit – 2 Eggs, Poultry and Meat: Eggs – Introduction, Usage in Kitchen, Structure of Egg, Classification, Grading of Eggs, Types, Selection, Storage and preparation of breakfast dishes with eggs. Poultry and Game: Introduction, Classification, Selection Criterion, Cuts of Poultry, Yield and simple Indian preparations. Meat: Characteristics, selection and grading, Classification (Bovines, Ovines and Swines), Categories, Cuts of Meat, Storage and handling.

Unit – 3 Fishes in cooking: Introduction, Types, Purchasing, Storing Considerations, Fish & Shellfish, Their Classification, Cuts of Fish, Popular Species of Fish, Classical preparations of Fish, Common cooking methods used for sea food.

Unit – 4 Vegetable, Cuts & Cookery: Introduction, Vegetables, Pigment and Colour Changes, Effect of Heat on vegetables, Cuts of Vegetables, nutritional and hygiene aspects. Some Indian Cuts on vegetables: Broccoli, Cabbage, Potatoes, Onions, Spinach, Cucumber, Tomatoes, avocado. Beetroot, French Beans, Gourd, Bottle Gourd, Pumpkin, Okra, Colocasia, Spinach, Carrot, Turnips

Practicals (NOT COVERED IN THIS VOLUME)

1.Understanding Methods of Cooking & HACCP Standards

2.Cooking in Professional Kitchen – Do’s & Don’t’s

3.Understanding Eggs and their simple Breakfast Preparations ;Preparation of:

Hard & soft boiled eggs.

4.Fried eggs.

5.Poached eggs.

6.Scrambled eggs.

7.Omelet’s (Plain, Spanish, Stuffed)

8.Familiarisation with, Poultry, Meats & Fishes – Their Simple Cuts and Cooking

9.Vegetables –Their usage and cooking precautions

10.Cuts of vegetables

•Julienne

•Jardiniere

•Dices

•Cubes

•Macedoine

•Paysanne

•Shredding

•Mire- poix

11.Blanching of Tomatoes and Capsicum.

12.Cooking vegetables:

13.Boiling (potatoes, peas)

14.Frying (Aubergine, Potatoes)

15.Steaming (Cabbage)

16.Braising (Potatoes)

17.Braising (Onions, cabbage)

18.Simple Vegetable and Meat Cookery

19.Identification of types of rice varieties & pulses.

20.Simple preparation of Boiled rice (Draining & Absorption) method.

21.Fired rice.

22.Simple dal preparation

23.Wheat, products like making chapattis, parathas, phulkas, Kulchas & puris.

24.Simple Breakfast Preparations:

25.Preparation of Puri/ Bhaji, Allo Paratha, Chola Bhatura,

26.Preparation of Continental Breakfast

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UNIT 1 METHODS OF COOKING

Program Name: V101:BSc (HTS) 2016 pattern, V102: BSc(HSCS) 2016 Pattern

Course Name: HTS201: Food Production Foundation –II

Written by: Dr R V Vadnere, School of Continuing Education,

Coordinator Editing, Instructional Technology Editing and additional writing: Dr Rajendra Vadnere, School of Continuing Education

Structure:

1.00 BEFORE WE BEGIN

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.

1.01 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

1.02 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.

1.04 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.

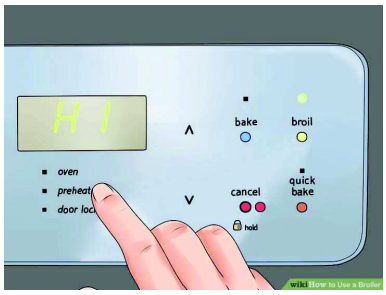
If you're oven has a broiler drawer, you will not be able to adjust the shelf height.

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

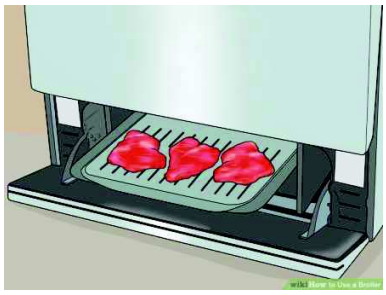
Use the right pans. Avoid putting glass or Pyrex dishes under your broiler. These materials may crack or explode when exposed to the high temperatures in a broiler. Instead, use sturdy metal or cast iron pans. For example:

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.

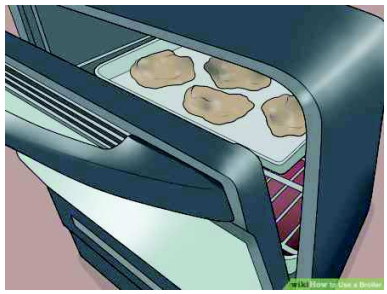
Step 2



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.

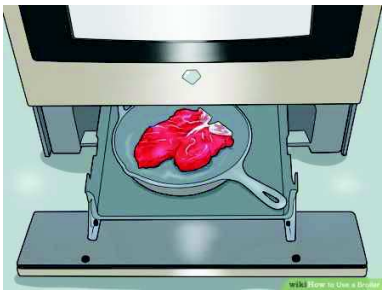
Leave the oven door or drawer closed. If the door is open, close it. This will cut off the oxygen supply to the fire.

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

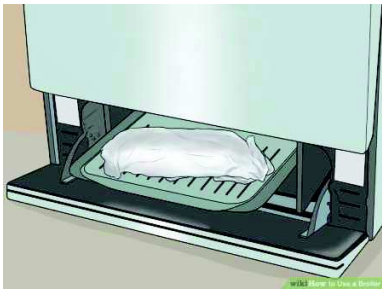


Broil a steak. First, place a cast iron skillet in the broiler. Preheat the oven and the skillet for 15-20 minutes. Next, place a seasoned steak in the hot cast-iron skillet. Broil the steak for three to five minutes per side. After the steak is cooked, let it rest for at least five minutes before serving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

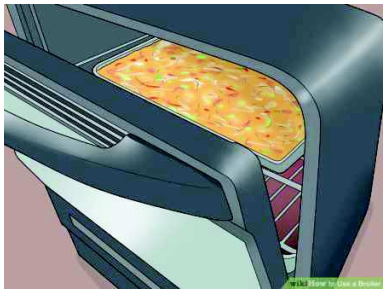
1 teaspoon of dried oregano

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?

1.05 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?

1.06 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?

1.07 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?

1.08 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?

1.09 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?

1.10 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?

1.11 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?

1.12 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?

1.13 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?

1.14 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?

1.15 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?

1.16 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

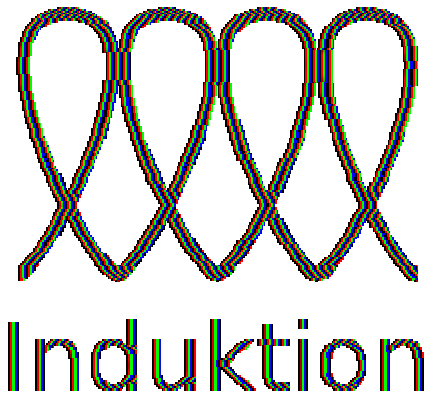


Fig 1.00: Cookware may carry a symbol that identifies it as compatible with an induction cooktop.

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
Stainless steel 432	24.5	200	0.007 (0.18)	3.5	87.5

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 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?

1.17 HACCP AND STANDARD KITCHEN

Hazard analysis and critical control points or **HACCP** (/ˈhæsʌp/) is a systematic preventive approach to food safety from biological, chemical, and physical hazards in production processes that can cause the finished product to be unsafe, and designs measurements to reduce these risks to a safe level. In this manner, HACCP is referred as the prevention of hazards rather than finished product inspection. The HACCP system can be used at all stages of a food chain, from food production and preparation processes including packaging, distribution, etc. The Food and Drug Administration (FDA) and the United States Department of Agriculture (USDA) require mandatory HACCP programs for juice and meat as an effective approach to food safety and

protecting public health. Meat HACCP systems are regulated by the USDA, while seafood and juice are regulated by the FDA. All other food companies in the United States that are required to register with the FDA under the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, as well as firms outside the US that export food to the US, are transitioning to mandatory Hazard Analysis and Risk-based Preventive Controls (HARPC) plans.

HACCP is believed to stem from a production process monitoring used during World War II because traditional "end of the pipe" testing on artillery shell's firing mechanisms could not be performed, and a large percentage of the artillery shells made at the time were either duds or misfiring. HACCP itself was conceived in the 1960s when the US National Aeronautics and Space Administration (NASA) asked Pillsbury to design and manufacture the first foods for space flights. Since then, HACCP has been recognized internationally as a logical tool for adapting traditional inspection methods to a modern, science-based, food safety system. Based on risk-assessment, HACCP plans allow both industry and government to allocate their resources efficiently in establishing and auditing safe food production practices. In 1994, the organization of *International HACCP Alliance* was established initially for the US meat and poultry industries to assist them with implementing HACCP and now its membership has been spread over other professional/industrial areas.

Principles

1. Conduct a hazard analysis

   Plans determine the food safety hazards and identify the preventive measures the plan can apply to control these hazards. A food safety hazard is any biological, chemical, or physical property that may cause a food to be unsafe for human consumption.

2. Identify critical control points

   A critical control point (CCP) is a point, step, or procedure in a food manufacturing process at which control can be applied and, as a result, a food safety hazard can be prevented, eliminated, or reduced to an acceptable level.

3. Establish critical limits for each critical control point

   A critical limit is the maximum or minimum value to which a physical, biological, or chemical hazard must be controlled at a critical control point to prevent, eliminate, or reduce that hazard to an acceptable level.

4. Establish critical control point monitoring requirements

   Monitoring activities are necessary to ensure that the process is under control at each critical control point. In the United States, the FSIS requires that each monitoring procedure and its frequency be listed in the HACCP plan.

5. Establish corrective actions

   These are actions to be taken when monitoring indicates a deviation from an established critical limit. The final rule requires a plant's HACCP plan to identify the corrective actions to be taken if a critical limit is not met. Corrective actions are intended to ensure that no product is injurious to health or otherwise adulterated as a result if the deviation enters commerce.

6. Establish procedures for ensuring the HACCP system is working as intended

   Validation ensures that the plants do what they were designed to do; that is, they are successful in ensuring the production of a safe product. Plants will be required to validate their own HACCP plans. FSIS will not approve HACCP plans in advance, but will review them for conformance with the final rule.
   Verification ensures the HACCP plan is adequate, that is, working as intended. Verification procedures may include such activities as review of HACCP plans, CCP records, critical limits and microbial sampling and analysis. FSIS is requiring that the HACCP plan include verification tasks to be performed by plant personnel. Verification tasks would also be performed by FSIS inspectors. Both FSIS and industry will undertake microbial testing as one of several verification activities.

   Verification also includes 'validation' – the process of finding evidence for the accuracy of the HACCP system (e.g. scientific evidence for critical limitations).

7. Establish record keeping procedures

   The HACCP regulation requires that all plants maintain certain documents, including its hazard analysis and written HACCP plan, and records documenting the monitoring of critical control points, critical limits, verification activities, and the handling of processing deviations.

Implementation involves monitoring, verifying, and validating of the daily work that is compliant with regulatory requirements in all stages all the time. The differences among those three types of work are given by Saskatchewan Agriculture and Food.

Standards

The seven HACCP principles are included in the international standard ISO 22000 FSMS 2005. This standard is a complete food safety and quality management system incorporating the elements of prerequisite programmes(GMP & SSOP), HACCP and the quality management system, which together form an organization's Total Quality Management system.

Other Standards, such as Safe Quality Food Institute's SQF Code, also relies upon the HACCP methodology as the basis for developing and maintaining Food Safety (Level 2) and Food Quality (Level 3) Plans and programs in concert with the fundamental prerequisites of Good Manufacturing Practices.

Training

Training for developing and implementing HACCP Food Safety management system are offered by several quality assurance companies. However, ASQ does provide a Trained HACCP Auditor (CHA) exam to individuals seeking professional training. In the UK the Chartered Institute of Environmental Health (CIEH) and Royal Society for Public Health offer HACCP for Food Manufacturing qualifications, accredited by the QCA (Qualifications and Curriculum Authority).

CHECK YOUR PROGRESS

What was the motivation to set HACCP?
Which are the principles of the HACCP?
How are the training offered on HACCP standards in various countries?

1.13 SUMMARY

In cooking, there are some basic methods of cooking that are used. These commonly used basic cooking methods are divided into two general groups: Dry heat cookery methods and Moist heat cookery methods. Some of the cooking methods studied in this units are summarized as follows.

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.

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

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

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.

Apart from the various cooking methods we also studied the HCCAP standards.

1.14 END QUESTIONS

The following questions should help you prepare for the End Examinations. These questions are for 5 marks each and should take you 11 minutes under examination conditions.

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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(All references accessed between 31 Dec 2016 to 04 Jan 2017)

UNIT 2 EGGS, POULTRY AND MEAT

Program Name: V101:BSc (HTS) 2016 pattern, V102: BSc(HSCS) 2016 Pattern

Course Name: HTS201: Food Production Foundation –II

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Structure:

2.00 BEFORE WE BEGIN

In this unit we will study the various types of non-vegtarian foods. We will begin with eggs. The eggs of hen, duck, ostrich and fish (caviar) are used as food item. We will study the culinary use of egg. The egg yolk is used as thickening agent and as emulsifier in cooking. We will study structure of egg. We will see that egg comprises of fifteen parts including egg shell, cuticula, chalaza, germinal disk, outer membrane, inner membrane, exterior albumin, middle albumin, vitelline membrane, nucleus of pander, air cell, yellow yolk, white and internal albumin, . We will also see that if the air cell is more in volume the quality of egg is poorer. (A very old egg will actually float in the water and should not be eaten). The eggs are classified according to their sizes. In US they are graded as AA, A, B, etc. The are also graded as jumbo, XL, L, M, S and peewee (in decreasing order of size). We will see that there are around six variety by quality of egg including omega 6, nest-laid, cage-free, free-run, free-range and organic. We

will study the health conditions which should be maintained for selecting good qulity eggs. Laying hens are often slaughtered between 100 and 130 weeks of age, when their egg productivity starts to decline. We will learn how to preserve eggs. A century egg or hundred-year-old egg is preserved by coating an egg in a mixture of clay, wood ash, salt, lime, and rice straw for several weeks to several months, depending on the method of processing. We will study how omelet can be **prepared in five** variety: classic filled omelette, a plain French omelette, a steamed omelette, and a baked omelette.

We will study the birds which are used as food, including chicken. Poultry are domesticated birds kept by humans for the eggs they produce, their meat, their feathers, or sometimes as pets. **Game** or **quarry** is any animal hunted for sport or for food. The edible components of chicken mainly include breast, leg and wing. We will see various breeds of chicken in India. There are only four pure Indian breeds of chicken available: aseel, Chittagong, Kadaknath and Busra**. Various breeds** developed by various government agencies will also be studied. We will study various cuts of poultry as defined by United States Department of Agriculture (USDA). The yield of actual edible part of poultry in comparison to the total product purchase has also been studied. As per a study by Texas A&M University, 70% yield in term of raw meat and skin is obtained when you purchase whole bird. Such information can be used to calculate the cost per kg for meat which is actually eaten. We also study reciepe of two chicken dishes in this Unit: Chicken Tandoori Paratha and Butter Chicken.

We study meat from mammals in the later sections of the unit. We see that there are three types of meat called bovine (from cattles), ovine (from sheep) and swine (from pigs). The pork is the most popular variety by consumption. The meat is classified by color as red meat and white meat. Beef is classified as red while poultry and pork is classified as white by most culinary standards. However, USDA defines all meat from mammals as red due to predominance of protein myoglobin. In 2015 the International Agency for Research on Cancer concluded that processed meat is definitely carcinogenic (Group 1) and found that for each additional 50g of processed meat consumed per day, the risk of colorectal cancer increased by 18% (up to a maximum of approximately 140g); it also found that there appeared to be an increase in gastric cancer but this was not as clear. We also study the cuts of lamb. The Lamb is divided into large sections called primal cuts. These large cuts are then broken down further into individual retail cuts that you buy at the supermarket or butcher's shop. The approximate zones of cuts a per UK system includes: Scrag end (of neck), Middle neck, Best End (of neck), Loin, Chump (and chump chops), Leg (gigot in Scotland), Shank, Shoulder, Breast. Finally we study how meat is stored and preserved. A number of techniques are discussed in this unit including tumbling, smoking, curing and chilling. We study effect of these techniques on the nutritional aspects. The commonest cured products are sausages, bacon, pork shoulder, ham, luncheon meat; any type of meat can be cured either as whole cuts or after comminution.

These concepts are extremely important in your development as a professional as they equip you with the necessary knolwdge about egg, meat, poultry and game. These would help you to understerstand the processes of food preparation, storage and preservation as well as health issues and nutritional aspects.

2.01 UNIT OBJECTIVES

After studying this unit you will be able to

- Describe the culinary uses of egg
- Explain the structure of egg
- Describe ways to classify eggs
- Explain how eggs are graded by size and quality.
- Describe importance of iiving conditions of the birds in selecting the eggs
- Explain how eggs are stored
- Describe some of the dishes prepared with eggs
- Describe the concept of poultry and games
- Explain how the poultry are classified
- Explain the various cuts of poultry.
- Describe the yield of poultry and recipes of some Indian dishes
- Explain the characteristics of meat.
- Explain the classification of meat as bovine, ovine and swines
- Explain the categorization of meat as red and white meat.
- Explain the various cuts of meat.
- Describe how meat is cured.

2.02 EGGS - INTRODUCTION

Eggs are laid by female animals of many different species, including birds, reptiles, amphibians, mammals, and fish, and have been eaten by humans for thousands of years. Bird and reptile eggs consist of a protective eggshell, albumen (egg white), and vitellus (egg yolk), contained within various thin membranes. The most popular choice for egg consumption are chicken eggs. Other popular choices for egg consumption are duck, quail, roe, and caviar.

Egg yolks and whole eggs store significant amounts of protein and choline, and are widely used in cookery. Due to their protein content, the United States Department of Agriculture categorizes eggs as Meats within the Food Guide Pyramid. Despite the nutritional value of eggs, there are some potential health issues arising from egg quality, storage, and individual allergies.

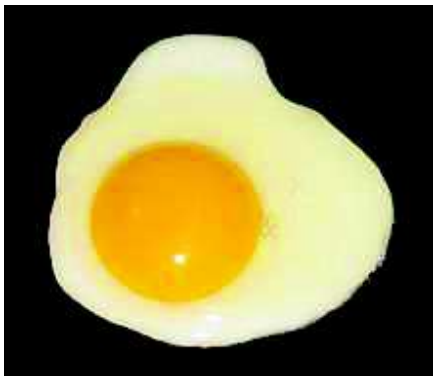


Fig 2.01: A fried chicken egg, "sunny side up"

Chickens and other egg-laying creatures are widely kept throughout the world, and mass production of chicken eggs is a global industry. In 2009, an estimated 62.1 million metric tons of eggs were produced worldwide from a total laying flock of approximately 6.4 billion hens. There are issues of regional variation in demand and expectation, as well as current debates concerning methods of mass production. The European Union recently banned battery husbandry of chickens..

CHECK YOUR PROGRESS

Which eggs are most popular?
What are the main parts of eggs?
What is the size of the egg industry?

2.03 EGGS: USAGE IN KITCHEN

Chicken eggs are widely used in many types of dishes, both sweet and savory, including many baked goods. Some of the most common preparation methods include scrambled, fried, hard-boiled, soft-boiled, omelettes and pickled. They can also be eaten raw, though this is not recommended for people who may be especially susceptible to salmonellosis, such as the elderly, the infirm, or pregnant women. In addition, the protein in raw eggs is only 51% bioavailable, whereas that of a cooked egg is nearer 91% bio-available, meaning the protein of cooked eggs is nearly twice as absorbable as the protein from raw eggs.

As an ingredient, egg yolks are an important emulsifier in the kitchen, and are also used as a thickener in custards.

Fig 2.02: Soft-boiled quail eggs, with potato galettes

The albumen, or egg white, contains protein, but little or no fat, and can be used in cooking separately from the yolk. The proteins in egg white allow it to form foams and aerated dishes. Egg whites may be aerated or whipped to a light, fluffy consistency, and are often used in desserts such as meringues and mousse.

Ground egg shells are sometimes used as a food additive to deliver calcium. Every part of an egg is edible, although the eggshell is generally discarded. Some recipes call for immature or unlaid eggs, which are harvested after the hen is slaughtered or cooked while still inside the chicken.

Cooking

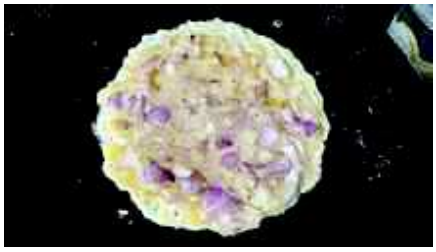


Fig 2.03: Half boiled egg dish

Eggs contain multiple proteins which gel at different temperatures within the yolk and the white, and the temperature determines the gelling time. Egg yolk gelifies, or solidifies, between 65 and 70 °C (149 and 158 °F). Egg white gels at different temperatures 60 to 73 °C (140 to 163 °F)- the white contains ovalbumin that sets at the highest temperature. However, in practice, in many cooking processes the white gels first because it is exposed to higher temperatures for longer.

Salmonella is killed instantly at 71 °C (160 °F), but is also killed from 54.5 °C (130.1 °F) if held there for sufficiently long time periods. To avoid the issue of salmonella, eggs can be pasteurized in-shell at 57 °C (135 °F) for an hour and 15 minutes. Although the white is slightly milkier, the eggs can be used in normal ways. Whipping for meringue takes significantly longer, but the final volume is virtually the same.

If a boiled egg is overcooked, a greenish ring sometimes appears around egg yolk due to the iron and sulfur compounds in the egg. It can also occur with an abundance of iron in the cooking water. The green ring does not affect the egg's taste; overcooking, however, harms the quality of the protein. Chilling the egg for a few minutes in cold water until it is completely cooled may prevent the greenish ring from forming on the surface of the yolk.

Peeling a cooked egg is easiest when the egg was put into boiling water as opposed to slowly heating the egg in cold water.

Flavor variations

Fig 2.04: A batch of tea eggs with shell intact soaking in a brew of spices and tea

Although the age of the egg and the conditions of its storage have a greater influence, the bird's diet does affect the flavor of the egg. For example, when a brown-egg chicken breed eats rapeseed or soy meals, its

intestinal microbes metabolize them into fishy-smelling triethylamine, which ends up in the egg. The unpredictable diet of free-range hens will produce unpredictable eggs. Duck eggs tend to have a flavor distinct from, but still resembling chicken eggs.

Eggs can also be soaked in mixtures to absorb flavor. Tea eggs are steeped in a brew from a mixture of various spices, soy sauce, and black tea leaves to give flavor.

CHECK YOUR PROGRESS

What happens if the boiled egg is overcooked?
What is the effect of the bird's diet on the taste of egg?
What are the uses of egg yolk in cooking?

2.04 STRUCTURE OF EGG

The shape of an egg resembles a prolate spheroid with one end larger than the other, with cylindrical symmetry along the long axis.

Fig 2.05: A raw chicken egg within its membrane, the shell removed by soaking in vinegar

An egg is surrounded by a thin, hard shell. Inside, the egg yolk is suspended in the egg white by one or two spiral bands of tissue called the chalazae (from the Greek word χάλαζα, meaning hailstone or hard lump).

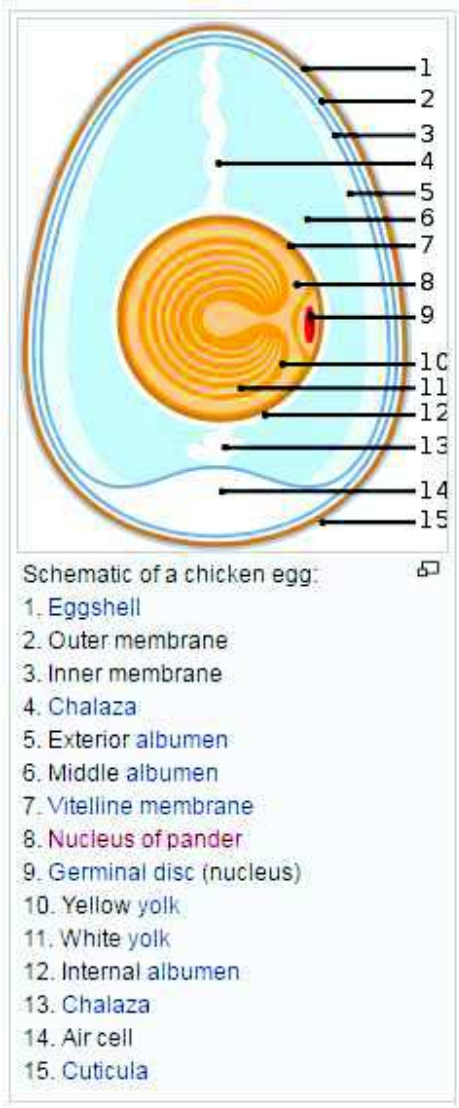


Fig 2.06: Structure of Egg

Air cell

The larger end of the egg contains the air cell that forms when the contents of the egg cool down and contract after it is laid. Chicken eggs are graded according to the size of this air cell, measured during candling. A very fresh egg has a small air cell and receives a grade of AA. As the size of the air cell increases and the quality of the egg decreases, the grade moves from AA to A to B. This provides a way of testing the age of an egg: as the air cell increases in size due to air being drawn through pores in the shell as water is lost, the egg becomes less dense and the larger end of the egg will rise to increasingly shallower depths when the egg is placed in a bowl of water. A very old egg will actually float in the water and should not be eaten.

Egg Shell

Egg shell color is caused by pigment deposition during egg formation in the oviduct and can vary according to species and breed, from the more common white or brown to pink or speckled blue-green. In general, chicken breeds with white ear lobes lay white eggs, whereas chickens with red ear lobes lay brown eggs. Although there is no significant link between shell color and nutritional value, there is often a cultural preference for one color over another (see 'Color of eggshell', below).

Membrane

The membrane is a clear film lining the eggshell, visible when one peels a boiled egg. Eggshell membrane is primarily composed of fibrous proteins such as collagen type I.

Egg White

White is the common name for the clear liquid (also called the albumen or the glair/glaire) contained within an egg. In chickens it is formed from the layers of secretions of the anterior section of the hen's oviduct during the passage of the egg. It forms around either fertilized or unfertilized yolks. The primary natural purpose of egg white is to protect the yolk and provide additional nutrition for the growth of the embryo.

Egg white consists primarily of about 90% water into which is dissolved 10% proteins (including albumins, mucoproteins, and globulins). Unlike the yolk, which is high in lipids (fats), egg white contains almost no fat and the carbohydrate content is less than 1%. Egg white has many uses in food, and many others, including the preparation of vaccines such as those for influenza.

Yolk

The yolk in a newly laid egg is round and firm. As the yolk ages, it absorbs water from the albumen, which increases its size and causes it to stretch and weaken the vitelline membrane (the clear casing enclosing the yolk). The resulting effect is a flattened and enlarged yolk shape.

Yolk color is dependent on the diet of the hen; if the diet contains yellow/orange plant pigments known as xanthophylls, then they are deposited in the yolk, coloring it. Lutein is the most abundant pigment in egg yolk. A colorless diet can produce an almost colorless yolk. Yolk color is, for example, enhanced if the diet includes products such as yellow corn and marigold petals. In the US, the use of artificial color additives is forbidden.

CHECK YOUR PROGRESS

What is the relationship between size of air cell and quality of the egg?
What is the effect of the diet of hen and color of egg yolk?
What are major nutrients in the egg white and egg yolk?

2.05 EGG CLASSIFICATION

Bird eggs are a common food and one of the most versatile ingredients used in cooking. They are important in many branches of the modern food industry.

The most commonly used bird eggs are those from the chicken. Duck and goose eggs, and smaller eggs, such as quail eggs, are occasionally used as a gourmet ingredient in western countries. Eggs are a common everyday food in many parts of Asia, such as China and Thailand, with Asian production providing 59% of the world total in 2013.

The largest bird eggs, from ostriches tend to be used only as special luxury food. Gull eggs are considered a delicacy in England, as well as in some Scandinavian countries, particularly in Norway. In some African countries, guineafowl eggs are commonly seen in marketplaces, especially in the spring of each year. Pheasant eggs and emu eggs are edible, but less widely available. Sometimes they are obtainable from farmers, poulterers, or luxury grocery stores. In many countries, wild birds' eggs are protected by laws which prohibit collecting or selling them, or permit collection only during specific periods of the year.

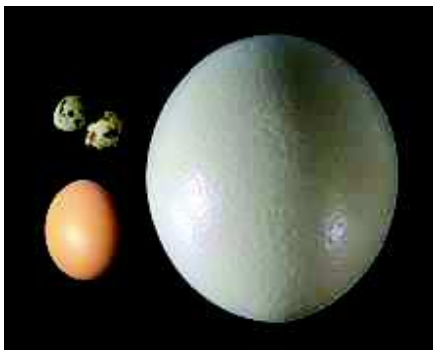


Fig 2.07: Quail eggs (upper left), chicken egg (lower left) and ostrich egg (right)

CHECK YOUR PROGRESS

Which are the common birds whose eggs are used in eating?
Which eggs are considered delicious in England?
What are the uses of eggs of Ostrich?

2.06 GRADING OF EGGS

The US Department of Agriculture grades eggs by the interior quality of the egg (see Haugh unit) and the appearance and condition of the egg shell. Eggs of any quality grade may differ in weight (size).

U.S. Grade AA

ggs have whites that are thick and firm; yolks that are high, round, and practically free from defects; and clean, unbroken shells.

Grade AA and Grade A eggs are best for frying and poaching, where appearance is important.

U.S. Grade A

Eggs have characteristics of Grade AA eggs except the whites are "reasonably" firm.

This is the quality most often sold in stores.

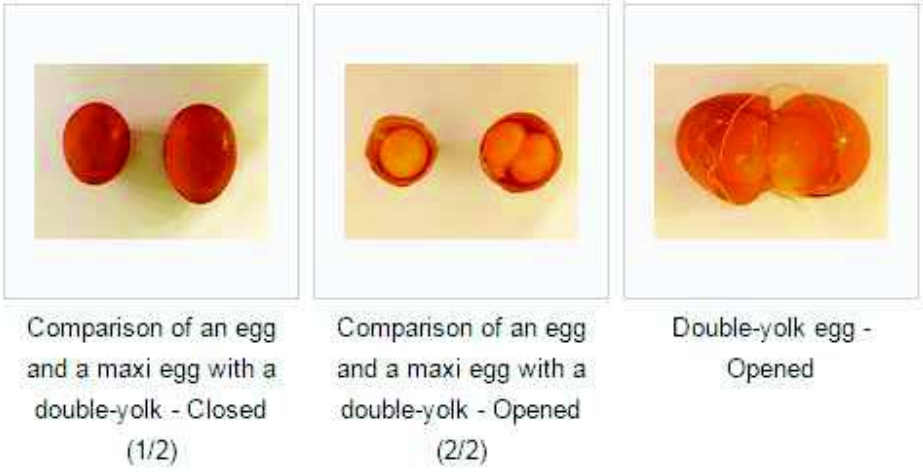
U.S. Grade B

Eggs have whites that may be thinner and yolks that may be wider and flatter than eggs of higher grades. The shells must be unbroken but may show slight stains.

This quality is seldom found in retail stores because they are usually used to make liquid, frozen, and dried egg products, as well as other egg-containing products.

In Australia and the European Union, eggs are graded by the hen farming method, free range, battery caged, etc.

Chicken eggs are also graded by size for the purpose of sales. Some maxi eggs can have double-yolk and some farms separate out double-yolk eggs for special sale.



Comparison of an egg and a maxi egg with a double-yolk - Closed (1/2)

Comparison of an egg and a maxi egg with a double-yolk - Opened (2/2)

Double-yolk egg - Opened

Fig 2.08: Double yolk egg

CHECK YOUR PROGRESS

Which quality of egg is mostly available in stores?
How are the eggs graded in Australia and European Union?
Why do farmers like to separate double yolk eggs?

Chicken eggs are graded by size, for the purpose of sales. The egg shell constitutes about 13% of the weight of the egg.

United States of America

The United States Department of Agriculture sizing is based by weight per dozen. The most common U.S. size of chicken egg is 'Large' and is the egg size commonly referred to for recipes. The following egg masses including shell have been calculated on the basis of the USDA sizing:

Modern Sizes (USA)			
Size	**Minimum mass per egg**		**Cooking Yield (Volume)**
Jumbo	70.9 g	2.5 oz.	
Very Large or Extra-Large (XL)	63.8 g	2.25 oz.	56 ml (4 tbsp)
Large (L)	56.7 g	2 oz.	46 ml (3.25 tbsp)
Medium (M)	49.6 g	1.75 oz.	43 ml (3 tbsp)
Small (S)	42.5 g	1.5 oz.	
Peewee	35.4 g	1.25 oz.	

Canada

In Canada, modern egg sizes are defined as follows:

Modern Sizes (Canada)	
Size	**Minimum mass per egg**
Jumbo	70 g
Extra Large	63 g
Large	56 g
Medium	49 g

Small	42 g
Peewee	Less than 42 g

Europe

In Europe, modern egg sizes are defined as follows.

Size	Minimum mass per egg
Extra large (XL)	73 g
Large (L)	63 g
Medium (M)	53 g
Small (S)	Less than 53 g

Australia

In Australia, the Australian Egg Corporation defines the following sizes in its labeling guide.

Modern Sizes (Australia)		
Size	**Mass range per egg**	**Average mass per egg**
King-size	71.7 g - 78.5 g	73 g
Jumbo	66.7 g - 71.6 g	68 g
Extra-Large	58.3 g - 66.6 g	60 g
Large	50.0 g - 58.2 g	52 g

Medium	41.7 g - 49.9 g	43 g

In Western Australia, two additional sizes are also standardized by the Golden Eggs Corporation

Additional Sizes (Western Australia)	
Mega or XXXL	72 g
Medium	43 g

New Zealand

In New Zealand sizes are based on the minimum mass per egg:

Modern Sizes (New Zealand)	
Size	**Minimum mass per egg**
Jumbo (8)	68 g
Large (7)	62 g
Standard (6)	53 g
Medium (5)	44 g
Pullet (4)	35 g

Traditional Sizes	
Size	**Mass range per egg**

Size 0	Greater than 75 g
Size 1	70 g - 75 g
Size 2	65 g - 70 g
Size 3	60 g - 65 g
Size 4	55 g - 60 g
Size 5	50 g - 55 g
Size 6	45 g - 50 g
Size 7	Less than 45 g

2.07 EGG TYPES

The six types of eggs you're eating, and how they're produced

Fig 2.09: Variouus Types of Eggs

According to chatelaine.com: eggs are our fallback for delicious weeknight meals and can't be beat when it comes to whipping up light and airy treats or rich and decadent desserts. But with the many varieties available on the market, it can be challenging to understand what all those labels mean. So here's a simple guide to crack the code of our favorite kitchen staple.

Omega-3
The only difference between regular eggs and omega-3 eggs is that the hens are fed with omega-3 fatty acid sources, such as flax seed. They are confined to cages, unless otherwise stated, and do not have access to litter, perches or nests.

Nest-laid
Nest-laid may seem promising, but this only means hens have access to a nest or perch within the confines of their cage.

Cage-free
Cage-free hens are not confined to a cage, however, that does not mean they have access to the outdoors, or that there are any requirements for how much space they have or for what feed or medicines they may be receiving.

Free-run
Free-run hens are able to roam in open-range barns, but do not have access to the outdoors and may not have access to natural light. However, they are usually provided access to nests, perches and litter.

Free-range
Free-range hens are able to roam in open-range barns and are given access to the outdoors (and natural light), when weather permits. They are also usually provided access to nests, perches and litter.

Organic
Organic is the only label with a legal definition and a third-party auditor to ensure organic regulations are being followed. Organic hens meet Canadian health and welfare standards with open-range barns, natural light indoors, free-access to pasture outdoors and always have access to nests, perches and litter. They are also fed 100% organic feed and are always provided with clean, fresh water. To be certified organic can be extremely costly, so there may be farmers in your area who produce eggs in a similar manner without the certification.

If you want peace of mind in terms of how your eggs were produced, hit up a local farmer's market and talk to the farmers who raise hens in your community. Don't be afraid to ask questions and support those whose values are in line with your own.

CHECK YOUR PROGRESS

What is organic egg?
How do you get omega-3 egg?

What is the difference between cage-free and free-run egg?

2.08 EGG SELECTION

Commercial factory farming operations often involve raising the hens in small, crowded cages, preventing the chickens from engaging in natural behaviors, such as wing-flapping, dust-bathing, scratching, pecking, perching, and nest-building. Such restrictions can lead to pacing and escape behavior.

Fig2.00: Laying hens in battery cages

Many hens confined to battery cages, and some raised in cage-free conditions, are debeaked to prevent them from harming each other and cannibalism. According to critics of the practice, this can cause hens severe pain to the point where some may refuse to eat and starve to death. Some hens may be force molted to increase egg quality and production level after the molting. Molting can be induced by extended feed withdrawal, water withdrawal or controlled lighting programs.

Laying hens are often slaughtered between 100 and 130 weeks of age, when their egg productivity starts to decline. Due to modern selective breeding, laying hen strains differ from meat production strains. As male birds of the laying strain do not lay eggs and are not suitable for meat production, they are generally killed soon after they hatch.

Free-range eggs are considered by some advocates to be an acceptable substitute to factory-farmed eggs. Free-range laying hens are given outdoor access instead of being contained in crowded cages. Questions on the actual living conditions of free-range hens have been raised in the United States of America, as there is no legal definition or regulations for eggs labeled as free-range in that country.

In the United States, increased public concern for animal welfare has pushed various egg producers to promote eggs under a variety of standards. The most widespread standard in use is determined by United Egg Producers through their voluntary program of certification. The United Egg Producers program includes guidelines regarding housing, food, water, air, living space, beak trimming, molting, handling, and transportation, however, opponents such as The Humane Society have alleged UEP Certification is misleading and allows a significant amount of unchecked animal cruelty. Other standards include "Cage

Free", "Natural", "Certified Humane", and "Certified Organic". Of these standards, "Certified Humane", which carries requirements for stocking density and cage-free keeping and so on, and "Certified Organic", which requires hens to have outdoor access and be fed only organic vegetarian feed and so on, are the most stringent.

Effective 1 January 2012, the European Union banned conventional battery cages for egg-laying hens, as outlined in EU Directive 1999/74/EC. The EU permits the use of "enriched" furnished cages that must meet certain space and amenity requirements. Egg producers in many member states have objected to the new quality standards while in some countries even furnished cages and family cages are subject to be banned as well. The production standard of the eggs is visible on the mandatory egg marking where the EU egg code begins with 3 for caged chicken to 1 for free-range eggs and 0 for organic egg production.

CHECK YOUR PROGRESS

When is a hen discontinued from battery?
What is the new (1999) requirement for standards of battery in European Union?

2.09 STORAGE AND PREPARATION OF DISHES WITH EGGS

Storage

Careful storage of edible eggs is extremely important, as an improperly handled egg can contain elevated levels of Salmonella bacteria that can cause severe food poisoning. In the US, eggs are washed, and this cleans the shell, but erodes the cuticle. The USDA thus recommends refrigerating eggs to prevent the growth of Salmonella.

Refrigeration also preserves the taste and texture. However, intact eggs can be left unrefrigerated for several months without spoiling. In Europe, eggs are not usually washed, and the shells are dirtier, however the cuticle is undamaged, and they do not require refrigeration. In the UK in particular, hens are immunized against salmonella, and the eggs are generally safe for 21 days.

Preservation

Fig 2.10: Salted duck egg

The simplest method to preserve an egg is to treat it with salt. Salt draws water out of bacteria and molds, which prevents their growth. The Chinese salted duck egg is made by immersing duck eggs in brine, or coating them individually with a paste of salt and mud or clay. The eggs stop absorbing salt after about a month, having reached osmotic equilibrium. Their yolks take on an orange-red color and solidify, but the white remains somewhat liquid. They are often boiled before consumption, and are often served with rice congee.

Fig 2.11: Pickled egg, colored with beetroot juice

Another method is to make pickled eggs, by boiling them first and immersing them in a mixture of vinegar, salt and spices, such as ginger or allspice. Frequently, beetroot juice is added to impart a red color to the eggs. If the eggs are immersed in it for a few hours, the distinct red, white, and yellow colors can be seen when the eggs are sliced. If marinated for several days or more, the red color will reach the yolk. If the eggs are marinated in the mixture for several weeks or more, the vinegar will dissolve much of the shell's calcium carbonate and penetrate the egg, making it acidic enough to inhibit the growth of

bacteria and molds. Pickled eggs made this way will generally keep for a year or more without refrigeration.

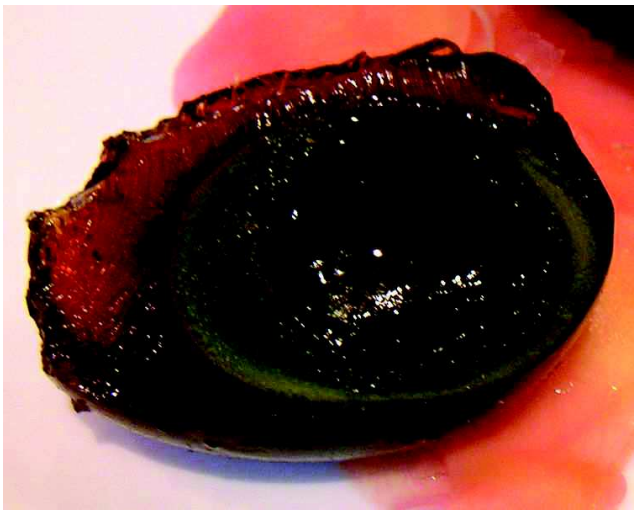


Fig 2.12: Century egg

Century egg

A century egg or hundred-year-old egg is preserved by coating an egg in a mixture of clay, wood ash, salt, lime, and rice straw for several weeks to several months, depending on the method of processing. After the process is completed, the yolk becomes a dark green, cream-like substance with a strong odor of sulfur and ammonia, while the white becomes a dark brown, transparent jelly with a comparatively mild, distinct flavor. The transforming agent in a century egg is its alkaline material, which gradually raises the pH of the egg from around 9 to 12 or more. This chemical process breaks down some of the complex, flavorless proteins and fats of the yolk into simpler, flavorful ones, which in some way may be thought of as an "inorganic" version of fermentation.

Cooking substitutes

For those who do not consume eggs, alternatives used in baking include other rising agents or binding materials, such as ground flax seeds or potato starch flour. Tofu can also act as a partial binding agent, since it is high in lecithin due to its soy content. Applesauce can be used, as well as arrowroot and banana. Extracted soybean lecithin, in turn, is often used in packaged foods as an inexpensive substitute for egg-derived lecithin. Chickpea brine, also known as aquafaba, can replace egg whites in desserts like meringues and mousses.

Other egg substitutes are made from just the white of the egg for those who worry about the high cholesterol and fat content in eggs. These products usually have added vitamins and minerals, as well as vegetable-based emulsifiers and thickeners such as xanthan gum or guar gum. These allow the product to maintain the nutrition and several culinary properties of real eggs, making possible foods such as Hollandaise sauce, custard, mayonnaise, and most baked goods with these substitutes.

CHECK YOUR PROGRESS

How is the pickled egg prepared?
What is a century egg?
What are the roles of salt in preserving egg?

How to Cook an Omelette: Four Ways

An omelet is a healthy, quick choice for breakfast or any meal of the week. All omelettes have eggs that are blended and lightly cooked, but the method for doing so differs greatly across cuisines. This article gives instructions for how to cook a classic filled omelette, a plain French omelette, a steamed omelette, and a baked omelette.

Preparation Time

- Prep time (Classic): 5-10 minutes
- Cook time: 10 minutes
- Total time: 15-20 minutes

Ingredients

Classic Filled Omelette

- 2-4 eggs
- Butter
- Omelette fillings (optional)
- Cheese, shredded
- Ham, turkey, chicken, sausage, or bacon
- Peppers, tomatoes, onions, spinach

French Herb Omelette

- 2-3 eggs
- Butter
- Dill, chives oregano, and other finely chopped herbs of your choice
- Salt and pepper to taste

Steamed Omelette

- 2-4 eggs
- 1 tablespoon grated carrot
- 1/2 finely chopped onion
- 1 teaspoon sesame oil
- Salt and pepper to taste

Baked Omelette

- 10 eggs

- 2 cups milk
- 1 cup grated Parmesan cheese
- 1 cup diced cooked ham or bacon
- 1/4 cup finely chopped fresh parsley
- 1 teaspoon salt
- Pepper to taste

Method 1 Classic Filled Omelette

Fig 2.13: Prepare the ingredients

Prepare the ingredients. Eggs cook quickly, so it is best to select and cut up all of your ingredients prior to cooking. First gather the number of eggs you want to cook; most omelettes have 2-4. Next chop your filling into bite-sized pieces and shred some cheese.

Some common omelette additions include onions, ham, bell peppers, green onions, spinach, sausage, olives, diced tomatoes and mushrooms. Use any or all of the ingredients, in a combination of your choice.

You can use cheddar cheese, swiss cheese, goat cheese, feta or any other type you like.

Fig 2.14 Break the eggs.

Break the eggs. Crack the eggs one at a time into a bowl. After breaking the eggs, be sure to wash your hands thoroughly to prevent salmonella poisoning.

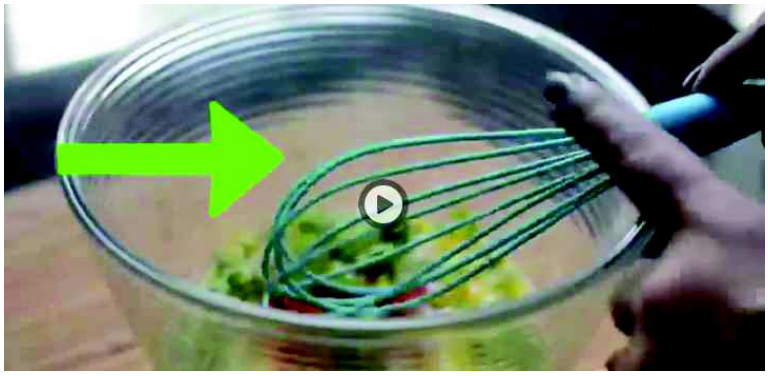


Fig 2.15: Beat the eggs until the yolks and whites are completely mixed.

You can either use a fork or wire whisk to beat the eggs. At this stage you can add salt, pepper, and other herbs and spices to the eggs as well.

Fig 2.16: Start cooking the eggs.

Heat some butter in the skillet over medium heat. Pour on the eggs, spreading them evenly with a spatula. Adding a splash of milk or water will help make the eggs a tad fluffy.

Fig 2.17: Add the fillings.

While the eggs are firm on the bottom, but still slightly runny on top, sprinkle all of the fillings except for the cheese over the eggs. Continue cooking the omelette until the eggs bubble on top.

Fig 2.18: Flip the omelette.

Use a spatula to gently flip the omelette to the other side. Keep cooking for another minute or two, until the omelette is no longer runny.

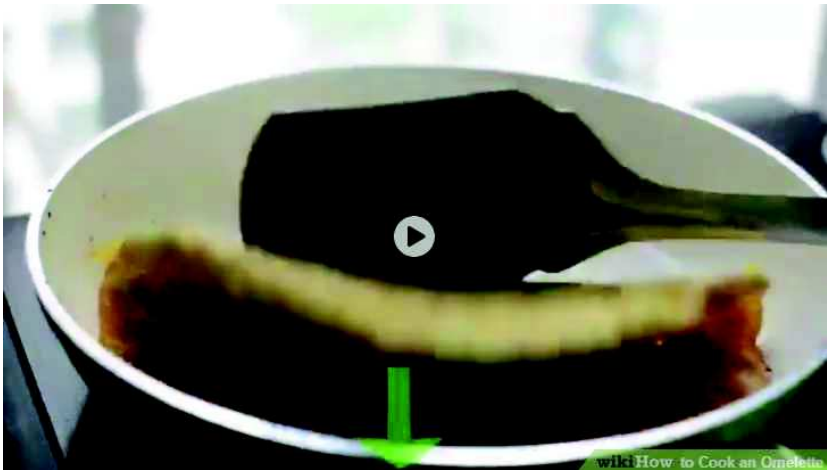


Fig 2.19: Fold the omelette.

Sprinkle the cheese into the center of the omelette, then use the spatula to gently fold the omelette in half over the cheese. Roll your omelette onto a plate.

Fig 2.20: Add cheese.

French Herb Omelette Method

Step 1: Heat a pat of butter in a small metal skillet.

Fig 2.21 Heat a pat of butter in a small metal skillet

Place the skillet on a burner and turn the heat to medium high. Let the butter melt completely and make sure the pan gets very hot.

Don't use a nonstick skillet to make an omelette using this technique. The high heat can cause the nonstick coating to flake off.

This method works best with just 2 eggs, but you could add a third if you're quite hungry.

Step 2: Beat and season the eggs

Fig 2.22: Beat and season the eggs.

While the butter is melting, put 2 or 3 eggs in a bowl and beat them with a whisk until the yolks and whites are combined. Using more eggs will create an omelette too thick to make with this technique; the egg mixture should spread thinly across the pan you are using. Season the eggs with a little salt and pepper, and sprinkle in chopped chives, oregano, dill, and other herbs to taste. 1/2 teaspoon of each seasons the eggs quite well.

Step 3: Pour the eggs into the pan

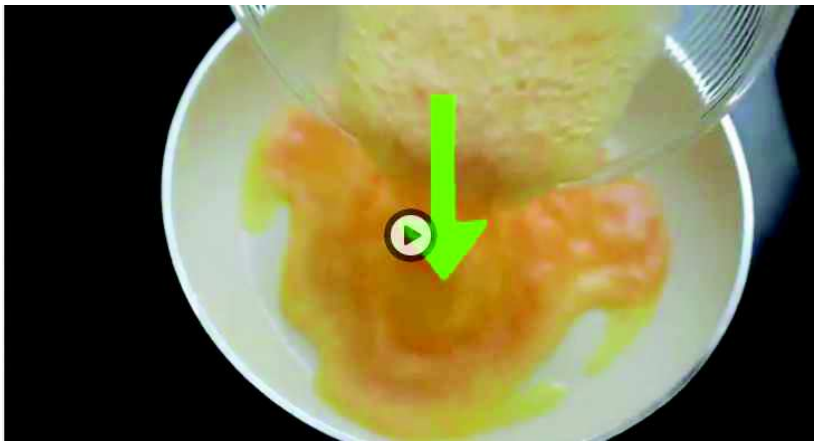


Fig 2.23: Pour the eggs into the pan.

Be sure the pan is very hot first; the butter should be sizzling. As soon as the eggs hit the pan they will begin to bubble and cook. Stay close by, since the eggs cook very quickly when you use this technique. Cook the first side for 30 seconds.

Image titled Cook an Omelette Step 12

Step 4: Flip the omelette

Fig 2.24:Flip the omelette.

Pick up the pan and quickly move your wrist in a circular motion to flip the omelette to the other side. Be careful not to let the omelette flip out of the pan; use a controlled motion so that it stays centered.

This technique can take some practice. The pan should have enough butter so that the omelette easily slides across its surface and flips.

Use a spatula to turn the omelette over if you'd prefer not to chance flipping it.

Fig 2.25: Slide the omelette onto a plate.

After the second side has cooked for about 20 seconds, slide the omelette onto a plate and use the lip of the pan to fold it over. This quick technique turns out simple, flavorful, perfectly cooked omelettes.

Method 3: Steamed Omelette

Fig 2.26: Mix the ingredients.

Beat the eggs, and mix in the carrot, onions, sesame oil, and salt and pepper to taste. Stir the combination well.

Fig 2.27: Pour the eggs into a steamer.

If you have a bamboo steamer, use that to steam the omelette. If you don't have a steamer, create one using two pots, a large one and a smaller one that fits inside. Fill the larger pot with a few inches of water, and set the smaller pot on top. Put the pots on the stove and turn it to medium heat. Pour the eggs into the smaller pot and put a lid on top.

Fig 2.28: Cook the eggs until they are set.

Let the steam cook the eggs for about 10 minutes, or until the top is set. When you jiggle the steamer or the pan, the eggs will move slightly, but they should no longer look wet.

Fig 2.29: Remove the omelette from heat and cut into slices. Serve immediately.

Method 4: Baked Omelette

Fig 2.30: Preheat the oven to 350 degrees.

Make sure it's fully hot before you cook the omelette.

Fig 2.31: Mix the ingredients.

Beat the eggs in a bowl, then mix in the milk, cheese, ham, parsley, and salt and pepper.

Fig 2.32: Pour the mixture into a greased baking dish.

Baked eggs tend to stick, so use butter, oil or cooking spray to grease the baking dish you are using. Pour the egg mixture into the dish.

Fig 2.33: Bake the omelette.

Place the baking dish in the oven and bake the omelette until the top is set, about 45 minutes. When you move the pan, the eggs should shake slightly, but they should no longer look wet or runny.

Fig 2.34: Remove the omelette from the oven and serve.

Cut the baked omelette into individual wedges for those you are serving. This baked omelette dish is delicious with toast or biscuits.

2.10 POULTRY AND GAME: INTRODUCTION

Poultry

Poultry (/ˌpoʊltriː/) are domesticated birds kept by humans for the eggs they produce, their meat, their feathers, or sometimes as pets. These birds are most typically members of the superorder Galloanserae (fowl), especially the order Galliformes (which includes chickens, quails and turkeys) and the family Anatidae, in order Anseriformes, commonly known as "waterfowl" and including domestic ducks and domestic geese. Poultry also includes other birds that are killed for their meat, such as the young of pigeons (known as squabs) but does not include similar wild birds hunted for sport or food and known as game. The word "poultry" comes from the French/Norman word poule, itself derived from the Latin word pullus, which means small animal.

Game

Game or **quarry** is any animal hunted for sport or for food. The type and range of animals hunted for food varies in different parts of the world. In some countries, game is classified, including legal classification with respect to licences required, as either "small game" or "large game"

Fig 2.35: Common pheasant, widely introduced and hunted as game

Chicken as food

Chicken is the most common type of poultry in the world. In developed countries, chickens are usually subject to intensive farming methods.

Fig 2.36: Oven-roasted rosemary and lemon chicken

The modern chicken is a descendant of red junglefowl hybrids along with the grey junglefowl first raised thousands of years ago in the northern parts of the Indian subcontinent.

Chicken as a meat has been depicted in Babylonian carvings from around 600 BC. Chicken was one of the most common meats available in the Middle Ages. It was eaten over most of the Eastern hemisphere and a number of different kinds of chicken such as capons, pullets and hens were eaten. It was one of the basic ingredients in the so-called white dish, a stew usually consisting of chicken and fried onions cooked in milk and seasoned with spices and sugar.

Fig 2.37: Chicken fry

In the United States in the 1800s, chicken was more expensive than other meats and it was "sought by the rich because it is so costly as to be an uncommon dish." Chicken consumption in the United States increased during World War II due to a shortage of beef and pork. In Europe, consumption of chicken overtook that of beef and veal in 1996, linked to consumer awareness of Bovine spongiform encephalopathy (mad cow disease).

Edible components

Breast: These are white meat and are relatively dry.

Leg: Comprises two segments:

- The "drumstick"; this is dark meat and is the lower part of the leg,
- the "thigh"; also dark meat, this is the upper part of the leg.

Wing: Often served as a light meal or bar food. Buffalo wings are a typical example. Comprises three segments:

- the "drumette", shaped like a small drumstick,
- the middle "flat" segment, containing two bones, and
- the tip, sometimes discarded.

Other

Chicken feet: These contain relatively little meat, and are eaten mainly for the skin and cartilage. Although considered exotic in Western cuisine, the feet are common fare in other cuisines, especially in the Caribbean and China.

Giblets: organs such as the heart, gizzards, and liver may be included inside a butchered chicken or sold separately.

Head: Considered a delicacy in China, the head is split down the middle, and the brains and other tissue is eaten.

Kidneys: Normally left in when a broiler carcass is processed, they are found in deep pockets on each side of the vertebral column.

Neck: This is served in various Asian dishes. It is stuffed to make helzel among Ashkenazi Jews.

Oysters: Located on the back, near the thigh, these small, round pieces of dark meat are often considered to be a delicacy.

Pygostyle (chicken's buttocks) and testicles: These are commonly eaten in East Asia and some parts of South East Asia.

By-products

Blood: Immediately after slaughter, blood may be drained into a receptacle, which is then used in various products. In many Asian countries, the blood is poured into low, cylindrical forms, and left to congeal into disc-like cakes for sale. These are commonly cut into cubes, and used in soup dishes.

Carcase and back: After the removal of the flesh, this is used for soup stock.

Chicken eggs: The most well-known and well-consumed byproduct.

Heart and gizzard: in Brazilian churrascos, chicken hearts are an often seen delicacy.

Liver: This is the largest organ of the chicken, and is used in such dishes as Pâté and chopped liver.

Schmaltz: This is produced by rendering the fat, and is used in various dishes.

Health

Chicken meat contains about two to three times as much polyunsaturated fat than most types of red meat when measured as weight percentage.

Chicken generally includes low fat in the meat itself (castrated roosters excluded). The fat is highly concentrated on the skin. A 100g serving of baked chicken breast contains 4 grams of fat and 31 grams of protein, compared to 10 grams of fat and 27 grams of protein for the same portion of broiled, lean skirt steak.

However, according to a 2006 Harvard School of Public Health study of 135,000 people, people who ate grilled skinless chicken 5 or more times a week had a 52 percent higher chance of developing bladder cancer compared to people who did not. However, such strong associations were not found in individuals regularly consuming chicken with skin intact

CHECK YOUR PROGRESS

Which are the edible components of a chicken?
What is a game?
What are the byproducts of chicken?

2.11 POULTRY CLASSIFICATION

Types of Indian pure breeds

There are only four pure Indian breeds of chicken available.

1. Aseel

- It is noted for its pugnacity, high stamina, majestic gait and dogged fighting qualities.
- The popular varieties of Aseel are, Peela (Golden red), Yakub (Black and red), Nuri (White), Kagar (Black), Chitta (Black and white spotted), Java (Black), Sabja (White and golden or black with yellow or silver), Teekar (brown) and Reza (light red).
- Pea comb, bright red wattle and ear lobes, long neck and strong legs

2. Chittagong

- It is also known as Malay.
- Dual-purpose bird.
- The popular varieties are buff, white, black, dark brown and grey.
- Pea comb, red ear lobes, over-hanging prominent eyebrows, feather-less shank

3. Kadaknath

- The skin, beak, shanks, toes and soles of feet are slate-like in colour
- Comb, wattles and tongue are purple.
- Most of the internal organs show intense black colouration and varying degrees of black colour are seen in the skeletal muscles, tendons, nerves, brain etc. The black pigment is due to the deposition of melanin.

4. Busra

- Medium sized bird, deep bodied, light feathered and alert in nature.
- Poor layer.
- Wide variation in body colour

Breeds of Poultry

Jharsim: A location specific rural poultry variety for Jharkhand

Jharsim is a dual purpose location specific poultry variety suitable for Jharkhand state. The variety is developed under All India Co-ordinated Research Project on Poultry Breeding, Birsa Agricultural University, Ranchi Centre.

The name Jharsim is derived from Jhar for Jarkhand and sim meaning hen in tribal dialect. These birds have attractive multi-colour plumage, perform better on low level of nutrition, faster growth, optimum egg production and better adaptability to agro climatic conditions of Jharkhand. The birds weigh 400-500g at 6 weeks and 1600-1800 g at maturity under backyard system. The age at first egg laying is 175-180 days and egg weight is 52-55g at 40 weeks of age.

The birds have the potential to lay 165-170 eggs and under backyard system. This variety can provide higher supplementary income and nutrition through both egg and meat to rural/ tribal population of the state.

Kamrupa: A dual purpose variety for free range farming in Assam

Fig 2.38: Kaamrupa

"Kamrupa" is a multi-coloured bird for rural poultry production developed under All India Coordinated Research Project on Poultry Breeding at Assam Agriculture University, Khanapara, Guwahati, Assam. It is three way cross developed using Assam local ecotype (25%), Coloured Broiler (25%) and Dalhem Red (50%) population. This variety has coloured plumage, mediocre body weight and longer shanks with optimum egg production. Under backyard system, the body weight at 8 and 20 weeks is 500-650 grams and 1300-1500grams, respectively. The male birds weigh 1800-2200 grams at 40 weeks of age the annual egg production is 118-130 eggs with an egg weight of 52 grams.

Pratapdhan: dual purpose coloured bird for Rajasthan

Pratapdhan is a dual purpose chicken variety to cater to the needs of rural poultry keepers of

Rajasthan. It was developed as part of AICRP on Poultry Breeding by MPUAT, Udaipur. It resembles local birds of Rajasthan. Attractive multicolour feather pattern, as rural people like coloured birds from aesthetic point of view and better looking. Because of colour plumage birds have camouflagic characters to protect themselves from predators. Birds have longer shank length which helps in self protection from predators in backyard areas and has capacity to

survive on low plane of nutrition (low and negligible input) and harsh climatic conditions. It lays brown eggs weighing around 50 g and has broody characteristic to some extent. It has fast growth rate with average adult body weight at 20 weeks of age ranged from 1478 to 3020 g in males and 1283 to 2736 g in females. The age at sexual maturity was 170 days. Pratapdhan produces 161 eggs annually, which is 274% higher than local native (43 eggs).

Breeds from Central Avian Research Institute (CARI), Izatnagar

Desi Types / Backyard Types

CARI NIRBHEEK (Aseel Cross)

Fig 2.39: CARI NIRBHEEK (Aseel Cross)

- The literal meaning of ***Aseel*** is real or pure. Aseel is well known for its pugnacity, high stamina, majestic gait and dogged fighting qualities. The name Aseel appears to have been given to this indigenous breed because of its inherent qualities of fighting.
- Andhra Pradesh is said to be the home of this important breed. The best specimen of this breed, although rare, are encountered with the fanciers and the people engaged in cock-fighting show through out the country.
- Aseel is larger in built with noble looking and dignified appearance.
- The standard weight varies from 3 to 4 kg for cocks and 2 to 3 kg for hens.
- Age at sexual maturity (days) 196 days
- Annual egg production (number) 92
- Egg weight at 40 week (g) 50.

CARI SHYAMA (Kadakanath Cross)

Fig 2.41: CARI SHYAMA (Kadakanath Cross)

- It is locally known as "Kalamasi" meaning the fowl having black flesh. Jhabua and Dhar districts of Madhya Pradesh and the adjoining districts of Rajasthan and Gujarat spreading over an area of about 800sq. miles is considered to be its home tract.
- These are mostly reared by tribals, adivasis and rural poor. It is considered to be a sacred bird and offered as sacrifice to Goddess after Diwali.
- The colour of the day old chicks is bluish to black with irregular dark stripes over the back.
- The flesh of this breed though black and repulsive to look at, is considered not only a delicacy but also of medicinal value.
- The tribal uses Kadakanath blood in the treatment of chronic disease in human beings and its meat as aphrodisiac.
- The meat and eggs are reckoned to be a rich source of protein (25.47% in flesh) and iron.
- Body weight at 20 weeks (g) 920
- Age at sexual maturity (days) 180
- Annual egg production (number) 105
- Egg weight at 40 week (g) 49
- Fertility (%) 55
- Hatchability FES (%) 52

HITCARI (Naked Neck Cross)

Fig 2.42: HITCARI (Naked Neck Cross)

- Naked neck is relatively larger in built with long cylindrical neck. As the name indicates, neck of the birds is fully naked or only a tuft of feathers is seen on the front of the neck above crop.
- The resulting bare skin becomes reddish particularly in males as they approach sexual maturity.
- Trivandrum region of Kerala is considered to be the homeland of Naked neck
- Body weight at 20 weeks (g) 1005
- Age at sexual maturity (days) 201
- Annual egg production (number) 99
- Egg weight at 40 week (g) 54
- Fertility (%) 66
- Hatchability FES (%) 71

UPCARI (Frizzle Cross)

Fig 2.43: UPCARI (Frizzle Cross)

Unique scavenging type birds developed with native breed base, having typical desi fowl look, better tropical adaptability and disease resistance, exceptional growth and production performance. Best suited for backyard system of poultry production.

Four varieties of UPCARI birds suitable for different agro-climatic conditions are available.

1. Kadakanath x Dehlam Red
2. Aseel x Dehlam Red
3. Naked Neck x Dehlam Red
4. Frizzle x Dehlam Red

Performance Profile

- Age at sexual maturity 170-180 days
- Annual egg production 165-180 eggs
  Egg size 52-55 g
- Egg colour Brown
- Egg quality Excellent Internal quality
- Livability Above 95%
- Temperament Active and good forager

Layers

CARI PRIYA LAYER

Fig 2.44: CARI PRIYA LAYER

- First egg at 17 to 18 weeks
- 50% production at 150 days
- Peak production at 26 to 28 weeks
- Liveability of grower (96%) and layer (94%)
- Egg production peak 92%
- Hen Housed to 72 wk. more than 270 eggs
- Egg size Average
- Egg weight 54 g

Cari Sonali Layer(Golden - 92)

Fig 2.45: Cari Sonali Layer(Golden - 92)

- First egg at 18 to 19 weeks
- 50% production at 155 days
- Peak production at 27 to 29 weeks
- Livability of grower (96%) and layer (94%)
- Egg production Peak 90%
- Hen Housed to 72 wk. more than 265 eggs
- Egg size Average
- Egg weight 54 g

CARI-DEVENDRA

- A medium -sized dual- purpose bird
- Efficient feed conversion - High positive return over feed cost
- Superiority over other stocks- Low laying house mortality
- Body weight at 8th week-1700-1800g
- Age at sexual maturity-155-160 days
- Annual egg production- 190-200

Broilers

CARIBRO-VISHAL (CARIBRO-91)

Fig 2.46: CARIBRO-VISHAL (CARIBRO-91)

- Weight at day old : 43g
- Weight at 6 weeks : 1650 to 1700g
- Weight at 7 weeks : 2100 to 2200g
- Dressing percentage : 75%
- Livability percentage : 97-98%
- Feed conversion ratio at 6 weeks : 1.94 to 2.20

CARI-RAINBRO (B-77)

Fig 2.47: CARI-RAINBRO (B-77)

- Weight at day old : 41g
- Weight at 6 weeks : 1300 g
- Weight at 7 weeks : 1600 g
- Dressing percentage : 73%
- Livability percentage : 98-99%
- Feed conversion ratio at 6 weeks : 2.3

CARIBRO-DHANRAJA (Multi-Coloured)

Fig 2.48: CARIBRO-DHANRAJA (Multi-Coloured)

- Weight at day old : 46g
- Weight at 6 weeks : 1600 to 1650g
- Weight at 7 weeks : 2000 to 2150g
- Dressing percentage : 73%
- Livability percentage : 97-98%
- Feed conversion ratio at 6 weeks : 1.90 to 2.10

CARIBRO-MRITUNJAI (CARI Naked Neck)

Fig 2.49: CARIBRO-MRITUNJAI (CARI Naked Neck)

- Weight at day old : 42g
- Weight at 6 weeks : 1650 to 1700g
- Weight at 7 weeks : 2000 to 2150g
- Dressing percentage : 77%
- Livability percentage : 97-98%
- Feed conversion ratio at 6 weeks : 1.9 to 2.0

Quails

Fig 2.50: Quails

- Japanese quail have created a big impact in recent years and many quails farms have been established through out the country both for egg and meat production. It is due to fact that increasing consumer awareness for quality meat.
- The following factors, which made quail farming as economically viable and technically feasible.
    - Very short generation interval
    - Quails are very robust to diseases
    - No vaccination is required
    - Low space requirement
    - Easy to handle
    - Early maturity
    - Very high laying intensity- female starts laying at an age of 42

CARI UTTAM

- Hatchability on total eggs set: 60-76%
- Weight at 4 weeks: 150 g
- Weight at 5 weeks: 170-190 g
- Feed efficiency at 4 weeks: 2.51
- Feed efficiency at 5 weeks: 2.80
- Daily feed consumption: 25-28 g

CARI UJJAWAL

- Hatchability on total eggs set 65%
- Weight at 4 weeks 140 g
- Weight at 5 weeks 170-175 g
- Feed efficiency at 5 weeks 2.93
- Daily feed consumption: 25-28 g

CARI SWETA

- Hatchability on total eggs set 50-60%
- Weight at 4 weeks 135 g
- Weight at 5 weeks 155-165 g
- Feed efficiency at 4 weeks 2.85
- Feed efficiency at 5 weeks 2.90
- Daily feed consumption: 25 g

CARI PEARL

- Hatchability on total eggs set: 65-70%
- Weight at 4 weeks: 120 g
- Daily feed consumption: 25 g
- Age at 50% egg production: 8-10 wk
- Hen day production: 285-295 eggs

Guinea fowl

Fig 2.51: Guinea fowl

- Guinea fowl are highly free moving birds.
- Best suited for marginal and small farmers
- Three available varieties are **KADMBARI, CHITAMBARI and SWETAMBARI**

Special features

- Hardy bird
- Suitable to any agro-climatic condition
- Resistant to many common diseases of chicken
- No requirement of elaborate and expensive housing
- Excellent foraging capabilities
- Consumes all non-conventional feed not used in chicken feeding
- More tolerant to mycotoxin and aflatoxin
- Hard egg shell provides minimum breakage and long keeping quality
- Guinea fowl meat is rich in vitamin and low in cholesterol

Production characteristics

- Weight at 8 weeks 500-550 g
- Weight at 12 weeks 900-1000 g
- Age at first egg 230-250 day
- Average egg weight 38-40 g
- Egg production (in one laying cycle from March to September) 100-120 eggs
- Fertility 70-75%
- Hatchability on fertile eggs set 70-80%

Turkey

CARI-VIRAT

Fig 2.52: CARI-VIRAT

- Broad Breasted White type
- Turkey is marketed as broiler at approximately 16 weeks of age when hens usually reach a live weight of about 8 kg and toms weigh approximately 12 kg.
- Smaller, fryer roasters can be produced by slaughtering at an earlier age as per the demand of the local market.

Breeds from The Directorate of Poultry Research (ICAR), Hyderabad.

Gramapriya

It is a layer type variety and was developed for free range farming in rural and tribal areas.

Fig 2.53: Gramapriya

The bird has the production potential of 230-240 eggs in a year and can lay 160-180 eggs in free-range conditions with minimum supplementary feeding. The males weigh around 1.2 to 1.5kg at 15 wks of age and suitable for tandoori preparations. The bird has coloured plumage and lays

bigger (57-59g) and brown eggs. It is hardy and livability is high. The rural and tribal farmers of many states are being profited by this variety.

Sinidhi

Srinidhi is a dual purpose variety for rural poultry production. Srinidhi has optimum body weight and better egg production. It was evaluated twice for full length of production cycle of 72 weeks at the Directorate of Poultry Research farm. Its juvenile body weight at 6 weeks of age was 650 g

Fig 2.54: Sinidhi

and males weighed 2353 g at 15 weeks of age. The age at sexual maturity was 161 days. The egg production upto 40 weeks of age was 90 eggs and the annual egg production was 228 eggs under intensive system of rearing. The survivability was more than 95%.

Subsequently, the variety was evaluated under field conditions in Tripura, Jharkhand and Andhra Pradesh. In the backyards, the juvenile body weight at 6 weeks of age was 500-550 g, the age at sexual maturity was 170-175 days. The egg production upto 40 weeks of age was 55-60 eggs and the bird has potential to lay 140-150 eggs per year under backyard.

Salient features under rural backyards

- Multi coloured plumage
- Longer shanks
- Coloured and bigger eggs (53-55 g)
- Juvenile b.wt. : 500-550 g at 6 weeks
- Early maturing (175 days)
- Annual egg production : 150 eggs

VANARAJA

Fig 2.55: VANARAJA

- Suitable bird for backyard farming in rural and tribal areas, developed by the Project Directorate on Poultry (ICAR), Hyderabad.
- It is a multi-coloured dual purpose bird with attractive plumage.
- It has better immune status against common poultry diseases and is adaptable to the free range rearing.
- Vanaraja males attain moderate body weight at 8 weeks of age under regular feeding system
- The hen lays 160-180 eggs in a laying cycle
- Due to their relatively light weight and long shanks, these birds are capable to protect themselves from predators which are otherwise a major problem observed in birds reared in backyards.

KRISHIBRO

Fig 2.56: KRISHIBRO

- Developed by the Project Directorate on Poultry (ICAR), Hyderabad.
- Multi-colored commercial broiler chicks
- Attain body weight by 6 weeks of age with less than 2.2 feed conversion ratios.
- The survivability of this bird up to 6 weeks of age is around 97%.
- These birds have attractive color plumage and are well adapted to tropical weather conditions.
- The commercial Krishibro has highly resistance against the common poultry diseases like Ranikhet and Infectious bursal disease.
- Advantages : Hardy, Well adapted and Better survivability

Breeds from Karnataka Veterinary Animal Fishery Science and University, Bangalore

Swarnadhara

Fig 2.57: Swarnadhara

Developed by Department of Poultry Science, University of Agricultural Sciences, Bangalore, presently Karnataka Veterinary Animal Fishery Sciences University, Hebbal, Bangalore

- This breed yields 15-20 eggs in a year more than Giriraja chicken breed and was released by the Karnataka Veterinary Animal Fishery Sciences University, Bangalore in 2005. Swarnadhara chickens have a high egg production potential along with better growth compared to other local varieties and are suited for mixed and backyard farming
- Compared to Giriraja breed, Swarnadhara breed are smaller in size with a lighter body weight, which makes them easier to escape attacks from predators such as jungle cats and foxes
- The bird can be reared for its eggs and meat.
- It attains maturity from the 22-23rd week after hatching.
- Hens attain a body weight of about 3 kg and the cocks about 4 kg.
- Swarnadhara hens lay about 180-190 eggs in a year.

Other native breeds

Breed	**Home Tract**
Ankaleshwar	Gujarat
Aseel	Chhattisgarh, Orissa and Andhra Pradesh
Busra	Gujarat and Maharashtra
Chittagong	Meghalaya and Tripura
Danki	Andhra Pradesh
Daothigir	Assam
Ghagus	Andhra Pradesh and Karnataka
Harringhata Black	West Bengal
Kadaknath	Madhya Pradesh
Kalasthi	Andhra Pradesh
Kashmir Faverolla	Jammu and Kashmir
Miri	Assam

Nicobari	Andaman & Nicobar
Punjab Brown	Punjab and Haryana
Tellichery	Kerala
Mewari	Rajasthan

Availability

Desi types or backyard types of poultry birds are being supplied by the following organisations

1. Breeds from Central Aviation Research Institute (CARI)
2. Directorate of Poultry Research (ICAR), Hyderabad
3. Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka
4. Kadaknath KB Livestock Farm

Source: Expert System on Poultry, ICAR-TANUVAS-TNAU

CHECK YOUR PROGRESS

Which are the pure breeds of Indian Chicken?
Which are some of the layered breeds?
Name at least five broiler breeds

2.12 CUTS OF POULTRY

Poultry is available fresh or frozen, as whole birds or as joints (cuts), bone-in or deboned, seasoned in various ways, raw or ready cooked. The meatiest parts of a bird are the flight muscles on its chest, called "breast" meat, and the walking muscles on the legs, called the "thigh" and "drumstick". The wings are also eaten (Buffalo wings are a popular example in the United States) and may be split into three segments, the meatier "drumette", the "wingette" (also called the "flat"), and the wing tip (also called the "flapper"). In Japan, the wing is frequently separated, and these parts are referred to as 手羽元 (teba-moto "wing base") and 手羽先 (teba-saki "wing tip").

Dark meat, which avian myologists refer to as "red muscle", is used for sustained activity—chiefly walking, in the case of a chicken. The dark colour comes from the protein myoglobin, which plays a key role in oxygen uptake and storage within cells. White muscle, in contrast, is suitable only for short bursts of activity such as, for chickens, flying. Thus, the chicken's leg and thigh meat are dark, while its breast meat (which makes up the primary flight muscles) is white. Other birds with breast muscle more suitable for sustained flight, such as ducks and geese, have red muscle (and therefore dark meat) throughout. Some cuts of meat including poultry expose the microscopic regular structure of intracellular muscle fibrils which can diffract light and produce iridescent colours, an optical phenomenon sometimes called structural colouration.

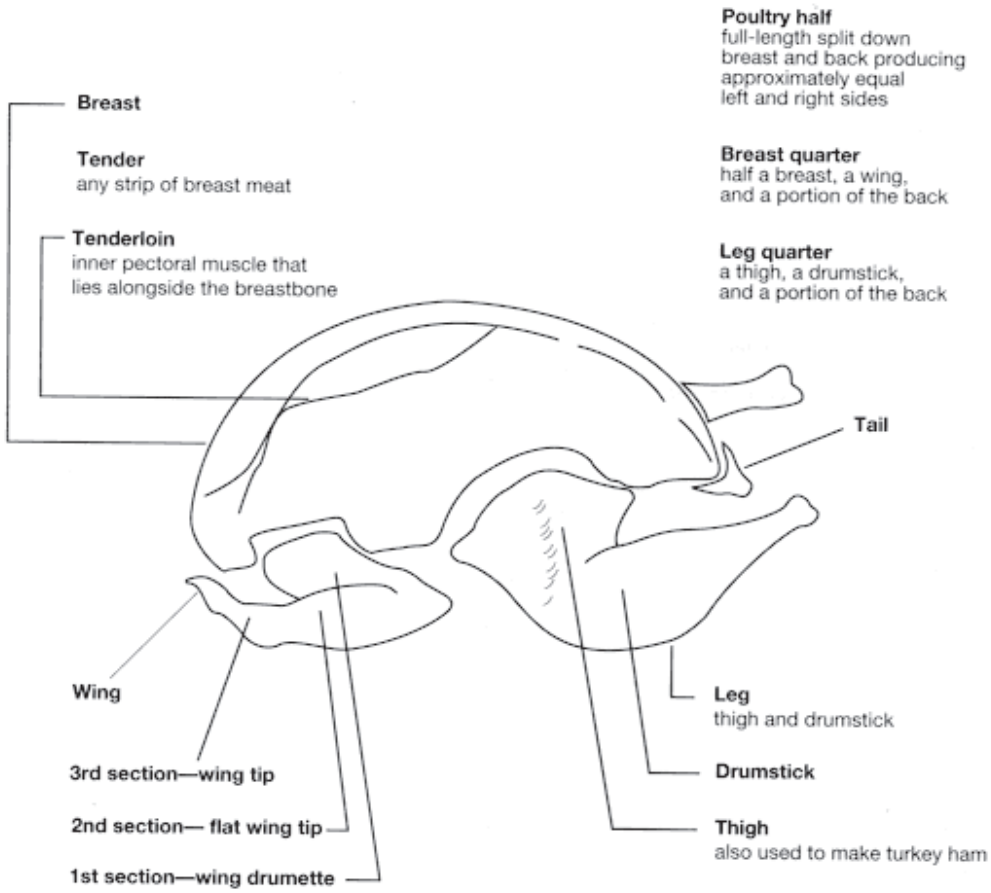


Fig 2.58: USDA poultry cuts

CHECK YOUR PROGRESS

In how many variety (as per cuts) are the chicken available?
Which protein is responsible for the red color of meat?
Show the various cuts of poltry as per USDA in a figure.

2.13 POULTRY YIELD AND SIMPLE INDIAN PREPARATIONS

Poultry Yield

According to JH Dentor and DB Mellor of Texas A&M University have made an interesting study (http://posc.tamu.edu/wp-content/uploads/sites/20/2012/08/l-2290.pdf) . They have prepared a table showing how much edit mass you would get if you buy say one kilogram of chicken product.

Chicken Product	Raw Meat and skin	Raw Meat only	Cooked (Fried)	Cooked (Roasted)	Cooked (Stew)
Whole	0.70	0.58	0.47	0.45	0.50
Whole cut-up	0.70	0.58	0.47	0.45	0.50
Whole boneless	1.00	0.82	0.68	0.65	0.72
Whole breast	0.85	0.68	0.54	0.54	0.61
Split breast	0.80	0.71	0.54	0.54	0.61
Boneless breast	1.00	0.89	0.68	0.63	0.76
Breast fillet	1.00	1.00	0.73	0.73	0.81
Breast tenderloin	1.00	1.00	0.73	0.73	0.81
Thigh	0.79	0.66	0.52	0.52	0.57
Boneless thigh	1.00	0.84	0.65	0.66	0.72
Drumstick	0.67	0.58	0.45	0.47	0.52
Wing	0.54	0.33	0.36	0.38	0.44

We make purchasing decisions based on our personal preferences, economy and convenience of cooking. Cost per serving is called economy which is important for restaurants and caterers. Convenience is important for busy people. In US, more and more pre-cut and boneless chicken products are being made available. Normally, whole chicken costs less per kg than cut up chicken parts or boneless meat products.

In the above table we make comparison of the raw and cooked yield is made. When you purchase one kg of whole chicken , (as per first row of the table) you get 0.70 kg of edible meat with skin and 0.58 kg of meat (without skin) and 0.47 kg of fried (floored but not battered) edible pieces and 0.45 kg of roasted chicken and 0.50 kg of stew.

Similarly when you purchase 1kg of whole breast (as purchased with bones) will get you 0.85kg of meat and skin and (no bones)and 0.68 kg of meat and no skin (no bones).

This yield analysis will be very useful in making pricing decisions. You can calculate cost per kg of any chicken product by dividing the cost of the product by the yield. Thus if the cost of whole chicken is 200 Rs/kg in your area at a given time then you get the yield value for raw meat and skin as

Cost per kg (meat and skin) = 200/0.70= 285.71 Rs/kg

We have used value of 0.70 as yield as per first row below raw meat and skin.

How to make spicy Chicken Tandoori Paratha

- Boneless chicken pieces (depends on the number of people)
- 3 teaspoons red chilli powder
- 1/2 teaspoon salt
- 1 pinch white soda
- Up to 8 green chillies
- Fresh coriander (dhaniya)
- Fresh mint (podina)
- 1/2 teaspoon black pepper

- 1 teaspoon vinegar
- Cucumber/olives/onions/tomatoes, etc (optional)
- Butter
- Shredded cheese
- 1/2 teaspoon sugar

Method

- Boil the chicken pieces for thirty minutes or until cooked to the bone.
- Put the chicken in a pot. Add the red chilli powder, salt, sugar, black pepper, shredded cheese, white soda and vinegar.
- Add a little oil just so the chicken does not stick to the bottom. Stir well and heat until the spices are fully cooked.
- Make a green paste while the chicken is cooking. Use 1 tomato, green chillies, a bunch of mint and coriander, 1 teaspoon salt, 1 teaspoon vinegar. Grind or blend the ingredients until you have a thick, rich, green paste.
- Put the parathas in a frying pan. Put 1 teaspoon butter on the paratha and cook it until it is fluffy and gold.
- Apply some butter on the paratha. Put your cooked tandoori chicken inside it with any fillings you desire.
- Put some green paste on top of the chicken and roll it up.
- Your roll is ready.

Tips

- You can add some salad to it, too.
- You can use any paste or sauce you like in your roll: hot sauce, ketchup, green chilli paste, mustard, garlic sauce, anything.
- If you don't have fresh parathas, you may be able to buy frozen parathas at a supermarket or an Indian food shop.
- Make your chicken tanduri paratha roll colourful and tasty according to your taste, bring Lahore to your place.

Warnings

Be careful of the vapor and aroma of the spices - do not burn your eyes.

Chicken Butter Masala

Ingredients

Marinade for chicken:

- 500 grams/17.6 oz chicken (cut into small pieces)
- 1 teaspoon ginger-garlic paste
- Salt (to taste)
- 1 teaspoon red chili powder
- 1/2 teaspoon turmeric powder

Sauce:

- 1 teaspoon ginger-garlic paste
- Fresh cream
- 4 tablespoons khoya (an Indian whole mill style of whey; ricotta cheese can be substituted)
- 2 teaspoons Kashmiri red chili powder
- 2 tablespoons kasuri methi (dried fenugreek leaves)
- 1 teaspoon cumin powder
- 1 teaspoon coriander (cilantro) powder
- 1/2 teaspoon grams masala powder
- 4-5 tomatoes, very ripe
- Crushed fried onion
- Salt and sugar to taste
- 3 tablespoons unmelted, soft butter
- Fresh coriander (cilantro) leaves (to garnish)

Method:

Marinade

Mix the chicken, yogurt, half a teaspoon of the ginger-garlic paste, salt, turmeric powder and red chili powder in a large bowl. Marinade overnight. (Marination makes the chicken juicy and tender, so overnight marination is recommended. However, if you're in hurry, then marinate for at least an hour.)

Cooking the Chicken

After marinating the chicken, heat the butter in a pan. Add only the chicken pieces—don't add the spice mixture just yet. Fry until the skin of the chicken becomes golden brown, in the same manner that you see for chicken tikka. Cook on medium-high heat for 10 minutes by turning over the side. Then cook slowly for another 10 minutes until the chicken is done.

Making the Sauce

In a large mixing bowl, mix the spices. Add another half teaspoon of the ginger-garlic paste, cumin powder, coriander powder, garam masala powder, kasuri methi or dry fenugreek leaves, kashmiri red chili powder and leftover spice mix. Also add the fried onion, salt and sugar to taste, and water**.**

Mix gently. The spice paste is ready to use.

In another pan, add butter to heat gently. Do not brown.

Add the prepared spice paste to the heated butter. Mix. Cook for 3-4 minutes on medium-high heat until the oil floats up.

Add the khoya and mix. Slowly cook for another 3-4 minutes

Adding the Tomatoes

Put the ripe tomatoes in hot, boiling water. Then transfer them to cold water. Once cooled enough to handle, you can easily remove the skin and stem. Make a tomato puree out of this using a blender or processor.

Add the tomato puree to the khoya mix. Mix and slowly cook for 5-6 minutes with the lid on.

Finishing the Cooking

Add the chicken pieces. Also add any sauce that remains on the chicken.

Add fresh cream. Cook until the cream is well stirred into the mixture.

Add a burnt butter garnish.

Take a small pan and add butter to it. Stir continuously and try to get the butter burnt. This most likely will cause a flame, so be careful when handling.

Put this burnt butter on the top of the chicken makhani. Mix and cover it.

Cover the dish until it served. If you don't cover it, the flavor may escape. You're now ready to serve!

CHECK YOUR PROGRESS

How do we make Tandoori Chicken Paratha?
How do we make butter chicken?
What will be the cost per kg if you purchase drumsticks at Rs 250 per kg and wish to make a roasted dish?

2.14 MEAT: CHARECTERISTICS

Meat is animal flesh that is eaten as food. Humans have hunted and killed animals for meat since prehistoric times. The advent of civilization allowed the domestication of animals such as chickens, sheep, pigs and cattle, and eventually their use in meat production on an industrial scale.

Meat is mainly composed of water, protein, and fat. It is edible raw, but is normally eaten after it has been cooked and seasoned or processed in a variety of ways. Unprocessed meat will spoil or rot within hours or days as a result of infection with and decomposition by bacteria and fungi.

Most often, meat refers to skeletal muscle and associated fat and other tissues, but it may also describe other edible tissues such as offal. Meat is sometimes also used in a more restrictive sense – the flesh of mammalian species (pigs, cattle, lambs, etc.) raised and prepared for human consumption, to the exclusion of fish, other seafood, poultry or other animals.

The domestication of animals, of which we have evidence dating back to the end of the last glacial period (c. 10,000 BC), allowed the systematic production of meat and the breeding of animals with a view to improving meat production. The animals which are now the principal sources of meat were domesticated in conjunction with the development of early civilizations:

Fig 2.59: A typical shoulder cut of lamb

Sheep, originating from western Asia, were domesticated with the help of dogs prior to the establishment of settled agriculture, likely as early as the 8th millennium BC. Several breeds of sheep were established in ancient Mesopotamia and Egypt by 3500–3000 BC. Presently, more than 200 sheep-breeds exist.

Cattle were domesticated in Mesopotamia after settled agriculture was established about 5000 BC, and several breeds were established by 2500 BC. Modern domesticated cattle fall into the groups Bos taurus (European cattle) and Bos indicus (zebu), both descended from the now-extinct aurochs. The breeding of beef cattle, cattle optimized for meat production as opposed to animals best suited for draught or dairy purposes, began in the middle of the 18th century.

Fig 2.60:A Hereford bull, a breed of cattle frequently used in beef production.

Domestic pigs, which are descended from wild boars, are known to have existed about 2500 BC in modern-day Hungary and in Troy; earlier pottery from Jericho and Egypt depicts wild pigs. Pork sausages and hams were of great commercial importance in Greco-Roman times. Pigs continue to be bred intensively as they are being optimized to produce meat best suited for specific meat products.

Other animals are or have been raised or hunted for their flesh. The type of meat consumed varies much between different cultures, changes over time, depending on factors such as tradition and the availability of the animals. The amount and kind of meat consumed also varies by income, both between countries and within a given country.

Horses are commonly eaten in France, Italy, Germany and Japan, among other countries. Horses and other large mammals such as reindeer were hunted during the late Paleolithic in western Europe.

Dogs are consumed in China, South Korea and Vietnam. Dogs are also occasionally eaten in the Arctic regions. Historically, dog meat has been consumed in various part of the world, such as Hawaii, Japan, Switzerland and Mexico.

Cats are consumed in Southern China and Peru.

Guinea pigs are raised for their flesh in the Andes.

Whales and dolphins are hunted, partly for their flesh, in Japan, Alaska, Siberia, Canada, the Faroe Islands, Greenland, Iceland, Saint Vincent and the Grenadines and by two small communities in Indonesia.

Modern agriculture employs a number of techniques, such as progeny testing, to speed artificial selection by breeding animals to rapidly acquire the qualities desired by meat producers. For instance, in the wake of well-publicised health concerns associated with saturated fats in the 1980s, the fat content of United Kingdom beef, pork and lamb fell from 20–26 percent to 4–8 percent within a few decades, due to both selective breeding for leanness and changed methods of butchery. Methods of genetic engineering aimed at improving the meat production qualities of animals are now also becoming available.

Fig 2.61: Fresh meat in a supermarket in North America

Even though it is a very old industry, meat production continues to be shaped strongly by the evolving demands of customers. The trend towards selling meat in pre-packaged cuts has increased the demand for larger breeds of cattle, which are better suited to producing such cuts. Even more animals not previously exploited for their meat are now being farmed, especially the more agile and mobile species, whose muscles tend to be developed better than those of cattle, sheep or pigs. Examples are the various antelope species, the zebra, water buffalo and camel, as well as non-mammals, such as the crocodile, emu and ostrich. Another important trend in contemporary meat production is organic farming which, while providing no organoleptic benefit to meat so produced, meets an increasing demand for organic meat.

CHECK YOUR PROGRESS

What is meat? What are the main compositions of meat?
When did the domestication of animal begin?
In which country the horses are consumed for food?

2.15 MEAT CLASSIFICATION (BOVINES, OVINES AND SWINES)

Bovine Meat

Bovine means, according to Merriam Webster Dictionary (online) "of, relating to, or resembling bovines and especially the ox or cow".

Beef is the culinary name for meat from cattle. Beef can be harvested from bulls, cows, heifers or steers. Its acceptability as a food source varies in different parts of the world.

Beef muscle meat can be cut into roasts, short ribs or steak (filet mignon, sirloin steak, rump steak, rib steak, rib eye steak, hanger steak, etc.). Some cuts are processed (corned beef or beef jerky), and trimmings, usually mixed with meat from older, leaner cattle, are ground, minced or used in sausages. The blood is used in some varieties of blood sausage. Other parts that are eaten include the oxtail, liver, tongue, tripe from the reticulum or rumen, glands (particularly the pancreas and thymus, referred to as sweetbread), the heart, the brain (although forbidden where there is a danger of bovine spongiform encephalopathy, BSE), the kidneys, and the tender testicles of the bull (known in the United States as calf fries, prairie oysters, or Rocky Mountain oysters). Some intestines are cooked and eaten as-is, but are more often cleaned and used as natural sausage casings. The bones are used for making beef stock.

Beef from steers and heifers is very similar. According to the most recent National Beef Quality Audit , heifer carcasses had slightly more marbling than steer carcasses, but USDA quality grade was not significantly different. Depending on economics, the number of heifers kept for breeding varies. The meat from older bulls is usually tougher, so it is frequently used for mince (known as ground beef in the United States). Cattle raised for beef may be allowed to roam free on grasslands, or may be confined at some stage in pens as part of a large feeding operation called a feedlot (or concentrated animal feeding operation), where they are usually fed a ration of grain, protein, roughage and a vitamin/mineral preblend.

Beef is the third most widely consumed meat in the world, accounting for about 25% of meat production worldwide, after pork and poultry at 38% and 30% respectively. In absolute numbers, the United States, Brazil, and the People's Republic of China are the world's three largest consumers of beef; however, Uruguay has the highest beef and veal consumption per capita, followed by Argentina and Brazil. According to the data from OECD, the average Uruguayan ate over 42 kg (93 lb) of beef or veal in 2014, representing the highest beef/veal consumption per capita in the world. In comparison, the average American consumed only about 24 kg (53 lb) beef or veal in the same year, while African countries, such as Mozambique, Ghana, and Nigeria, consumed the least beef or veal per capita.

In 2015, the world's largest exporters of beef were India, Brazil and Australia. Beef production is also important to the economies of Uruguay, Canada, Paraguay, Mexico, Argentina, Belarus and Nicaragua.

Ovine Meat

Ovine means "related to sheep". The sheep (Ovis aries) is a quadrupedal, ruminant mammal typically kept as livestock. Like all ruminants, sheep are members of the order Artiodactyla, the even-toed ungulates. Although the name "sheep" applies to many species in the genus Ovis, in everyday usage it almost always refers to Ovis aries. Numbering a little over one billion, domestic sheep are also the most

numerous species of sheep. An adult female sheep is referred to as a ewe (/ju:/), an intact male as a ram or occasionally a tup, a castrated male as a wether, and a younger sheep as a lamb.

Sheep are most likely descended from the wild mouflon of Europe and Asia. One of the earliest animals to be domesticated for agricultural purposes, sheep are raised for fleece, meat (lamb, hogget or mutton) and milk. A sheep's wool is the most widely used animal fiber, and is usually harvested by shearing. Ovine meat is called lamb when from younger animals and mutton when from older ones. Sheep continue to be important for wool and meat today, and are also occasionally raised for pelts, as dairy animals, or as model organisms for science.

Sheep husbandry is practised throughout the majority of the inhabited world, and has been fundamental to many civilizations. In the modern era, Australia, New Zealand, the southern and central South American nations, and the British Isles are most closely associated with sheep production.

Sheepraising has a large lexicon of unique terms which vary considerably by region and dialect. Use of the word sheep began in Middle English as a derivation of the Old English word scēap; it is both the singular and plural name for the animal. A group of sheep is called a flock, herd or mob. Many other specific terms for the various life stages of sheep exist, generally related to lambing, shearing, and age.

Being a key animal in the history of farming, sheep have a deeply entrenched place in human culture, and find representation in much modern language and symbology. As livestock, sheep are most often associated with pastoral, Arcadian imagery. Sheep figure in many mythologies—such as the Golden Fleece—and major religions, especially the Abrahamic traditions. In both ancient and modern religious ritual, sheep are used as sacrificial animals.

Sheep meat and milk were one of the earliest staple proteins consumed by human civilization after the transition from hunting and gathering to agriculture. Sheep meat prepared for food is known as either mutton or lamb. "Mutton" is derived from the Old French moton, which was the word for sheep used by the Anglo-Norman rulers of much of the British Isles in the Middle Ages. This became the name for sheep meat in English, while the Old English word sceap was kept for the live animal. Throughout modern history, "mutton" has been limited to the meat of mature sheep usually at least two years of age; "lamb" is used for that of immature sheep less than a year.

In the 21st century, the nations with the highest consumption of sheep meat are the Arab States of the Persian Gulf, New Zealand, Australia, Greece, Uruguay, the United Kingdom and Ireland. These countries eat 14–40 lbs (3–18 kg) of sheep meat per capita, per annum. Sheep meat is also popular in France, Africa (especially the Maghreb), the Caribbean, the rest of the Middle East, India, and parts of China. This often reflects a history of sheep production. In these countries in particular, dishes comprising alternative cuts and offal may be popular or traditional. Sheep testicles—called animelles or lamb fries—are considered a delicacy in many parts of the world. Perhaps the most unusual dish of sheep meat is the Scottish haggis, composed of various sheep innards cooked along with oatmeal and chopped onions inside its stomach. In comparison, countries such as the U.S. consume only a pound or less (under 0.5 kg), with Americans eating 50 pounds (22 kg) of pork and 65 pounds (29 kg) of beef. In addition, such countries rarely eat mutton, and may favor the more expensive cuts of lamb: mostly lamb chops and leg of lamb.

Though sheep's milk may be drunk rarely in fresh form, today it is used predominantly in cheese and yogurt making. Sheep have only two teats, and produce a far smaller volume of milk than cows. However, as sheep's milk contains far more fat, solids, and minerals than cow's milk, it is ideal for the cheese-making process. It also resists contamination during cooling better because of its much higher calcium content. Well-known cheeses made from sheep milk include the Feta of Bulgaria and Greece, Roquefort of France, Manchego from Spain, the Pecorino Romano (the Italian word for sheep is pecore) and Ricotta of Italy. Yogurts, especially some forms of strained yogurt, may also be made from sheep milk. Many of these products are now often made with cow's milk, especially when produced outside their country of origin. Sheep milk contains 4.8% lactose, which may affect those who are intolerant.

Fig 2.62:Shoulder of lamb

As with other domestic animals, the meat of uncastrated males is inferior in quality, especially as they grow. A "bucky" lamb is a lamb which was not castrated early enough, or which was castrated improperly (resulting in one testicle being retained). These lambs are worth less at market.

Swine Meat

Pork is the culinary name for meat from the domestic pig (Sus domesticus). It is the most commonly consumed meat worldwide, with evidence of pig husbandry dating back to 5000 BC. Pork is eaten both freshly cooked and preserved. Curing extends the shelf life of the pork products. Ham, smoked pork, gammon, bacon and sausage are examples of preserved pork. Charcuterie is the branch of cooking devoted to prepared meat products, many from pork.

Fig 2.63: Pork belly cut, shows layers of muscle and fats

Pork is the most popular meat in East and Southeast Asia, and is also very common in the Western world. It is highly prized in Asian cuisines for its fat content and pleasant texture. Judaism forbids the consumption of pork by Jews, and Islam forbids pork consumption by Muslims; and the sale of pork is illegal or severely restricted in Israel and certain Muslim countries due to the way the pigs were slaughtered and for hygiene reasons pigs have, like playing in the mud, especially those with sharia law as part of their constitution.

Pork is the most widely eaten meat in the world, accounting for about 38% of meat production worldwide. Consumption varies widely from place to place. The meat is taboo to eat in the Middle East and most of the Muslim world because of Jewish kosher and Islamic Halal dietary restrictions. But pork is widely consumed in East and Southeast Asia, Europe, Sub-Saharan Africa, the Americas and Oceania. As the result, large numbers of pork recipes are developed throughout the world. Feijoada for example, the national dish of Brazil (also served in Portugal), is traditionally prepared with pork trimmings: ears, tail and feet.

According to the USDA's Foreign Agricultural Service, nearly 100 million metric tons of pork were consumed worldwide in 2006 (preliminary data). Increasing urbanization and disposable income has led to a rapid rise in pork consumption in China, where 2006 consumption was 20% higher than in 2002, and a further 5% increase projected in 2007. In 2015 recorded total 109.905 million metric tons of pork were consumed worldwide

CHECK YOUR PROGRESS

Which type of meat is the most consumed in the world?
What is meant by bovine, ovine and swine?
What is the name for meat of the young sheep?

2.16 MEAT CATEGORIES

Red meat

Commonly, especially in gastronomy, red meat or dark meat is red when raw and dark in color when cooked, in contrast to white meat, which is pale in color before and after cooking. This definition only refers to flesh from mammals or fowl.

In nutritional science, red meat is defined as any meat that has more myoglobin than white meat, white meat being defined as non-dark meat from chicken (excluding leg or thigh), or fish. Some meat, such as pork, is red meat using the nutritional definition, and white meat using the common definition.

Definition: Red Meat

According to the USDA, all meats obtained from mammals (regardless of cut or age) are red meats because they contain more myoglobin than white meat like chicken or fish.

The culinary definition has many rules and exceptions. Generally meat from mammals (for example cattle, horse meat, bull meat) and meat from hunting (wild boars, deer, pigeons, partridges, quail and pheasant) excluding fish and insects are considered red meat. Although poultry is usually considered white, duck and goose are red. For some animals the culinary definition of red meat differs by cut, and sometimes by the age of the animal is when it was slaughtered. Pork is considered red if the animal is adult, but white if young (e.g. suckling pig). The same applies to young lamb and veal. Game is sometimes put in a separate category altogether. (French: viandes noires — "dark meats".)

Pork is considered white under the culinary definition, but red in nutritional studies. The National Pork Board has positioned it as "Pork. The Other White Meat", profiting from the ambiguity to suggest that pork has the nutritional properties of white meat, which is considered more healthful.

Nutrition: Red Meat

Red meat contains large amounts of iron, creatine, minerals such as zinc and phosphorus, and B-vitamins: (niacin, vitamin B12, thiamin and riboflavin). Red meat is a source of lipoic acid.

Red meat contains small amounts of vitamin D. The liver contains much higher quantities than other parts of the animal.

The accompanying website for the 2005 edition of the USDA food guide pyramid, MyPyramid stated that "fish, nuts, and seeds contain healthy oils, so choose these foods frequently instead of meat or poultry" and for people who wanted to eat meat, it recommended lean or low-fat red meat and poultry. In 2011, the USDA launched MyPlate, which didn't distinguish between kinds of meat, but did recommend eating at least 8 oz of fish each week. In 2011, the Harvard School of Public Health launched the Healthy Eating Plate because of the perceived inadequacies of the USDA's recommendations and presentation. The Healthy Eating Plate encourages consumers to limit red meat and avoid processed meat, and to instead choose fish, poultry, beans or nuts. Its website says: "Eating a lot of red meat and processed meat has been linked to increased risk of heart disease, diabetes, and colon cancer. So it's best to avoid processed meat, and to limit red meat to no more than twice a week. Switching to fish, chicken, nuts, or beans in place of red meat and processed meat can improve cholesterol levels and can lower the risk of heart disease and diabetes.

Red meat is not a uniform product; its health effects can vary based on fat content, processing and preparation. Processed red meat is linked to higher mortality, mainly due to cardiovascular diseases and cancer. There is some evidence too that the consumption of unprocessed red meat may have negative health effects in humans.

Health Concerns: Red Meat

A 2016 literature review reported that for 100g or more per day of red meat consumed, the risk increased 11% for each of stroke and for breast cancer, 15% for cardiovascular mortality, 17% for colorectal cancer, and 19% for advanced prostate cancer.

In 2015 the International Agency for Research on Cancer concluded that red meat is probably (Group 2A) carcinogenic to humans, and has reported that for each additional 100g (up to a maximum of approximately 140g) of red meat consumed per day, the risk of colorectal cancer increased by 17%; there also appeared to be increased of pancreatic cancer and prostate cancer but the association was not as clear.

Put in perspective, in the UK, 56 out of 1000 people who eat the lowest amount of red meat will develop colorectal cancer (5.6%) while 66 out of 1000 high-red meat eaters will develop colorectal cancer (6.6%) (1.17 x 5.6 = 6.6).

A 2013 meta-analysis found an increased risk of gastric cancer with higher consumption of red or processed meat. Red meat itself contains certain factors that, under certain conditions, produce carcinogens like N-nitroso compounds (NOCs).

The consensus on the role of red meat consumption to increased risk of cardiovascular diseases has changed in recent years. Studies that differentiate between processed and fresh red meat have failed to find a link between unprocessed red meat consumption and heart disease. A major Harvard University meta-study in 2010 involving over one million people who ate meat found that only processed meat had an adverse risk in relation to coronary heart disease (CHD). The study suggests that the "differences in salt and preservatives, rather than fats, might explain the higher risk of heart disease and diabetes seen with processed meats, but not with unprocessed red meats." Some mechanisms that have been suggested for why red meat consumption might be risk factor for cardiovascular disease include: its impact on serum cholesterol, that red meat contains arachidonic acid, heme iron, homocysteine, and its high saturated fat content.

Several studies have found a correlation between unprocessed red meat and the occurrence of CHD and certain types of stroke and have controlled for various confounding risk factors. A study of 84,000 women, over a period of 26 years, finds that those with the highest intake of unprocessed red meat, have a 13% increased risk of CHD. Likewise a Harvard study published in 2012, studying mortality as a result of processed and unprocessed red meat consumption finds that one serving of either type of meat a day results in an increased risk of mortality of 13%, while this ratio is indicative of cancer and cardiovascular (CVD) disease, the study indicates that of the 23,926 deaths investigated during the course of the study, 5910 of them were related to CVD and there was no statistical significance between the risk of unprocessed and processed red meats factors in the occurrence of CVD. The disparity between metadata studies definitely need to be addressed, because while one points toward unprocessed red meat being insignificant in certain health risks, there are still correlations to be found in focused large cohort studies.

Unprocessed red meat intake is tentatively associated with an increased risk of type II diabetes, but the link is weaker and less certain than the link between processed red meat and diabetes. Other findings have suggested that the association may be due to saturated fat, trans fat and dietary cholesterol, rather than red meat per se. One study estimated that “substitutions of one serving of nuts, low-fat dairy, and whole grains per day for one serving of red meat per day were associated with a 16–35% lower risk of type 2 diabetes”.

Processed meat

A 2016 literature review found that for the each additional 50g per day of processed meat (e.g., bacon, ham, hot dogs, sausages) consumed, the risk increased 4% for total prostate cancer, 8% for cancer mortality, 9% for breast cancer, 18% for colorectal cancer, 19% for pancreatic cancer, 13% for stroke, 24% for cardiovascular mortality and 32% for diabetes.

In 2015 the International Agency for Research on Cancer concluded that processed meat is definitely carcinogenic (Group 1) and found that for each additional 50g of processed meat consumed per day, the

risk of colorectal cancer increased by 18% (up to a maximum of approximately 140g); it also found that there appeared to be an increase in gastric cancer but this was not as clear. IARC's Press Release 240, based on a review of 800 studies over 20 years does not distinguish in this manner, defining processed meat as follows: "Processed meat refers to meat that has been transformed through salting, curing, fermentation, smoking, or other processes to enhance flavour or improve preservation. Most processed meats contain pork or beef, but processed meats may also contain other red meats, poultry, offal, or meat by-products such as blood."

Nitrates and nitrites found in processed meat (e.g. bacon, ham, salami, pepperoni, hot dogs, and some sausages) can be converted by the human body into nitrosamines that can be carcinogenic, causing mutation in the colorectal cell line, thereby causing tumorigenesis and eventually leading to cancer.

Cooking

Cooking any meat at high temperature and smoking produces the carcinogens polycyclic aromatic hydrocarbon compounds (PAHs) and heterocyclic amines (HCA). The subgroups of heterocyclic amines compounds are Amino-dimethylimidazo-Quinoxaline (MelQx), Amino-Dimethylimidazo-Quinoxaline (DiMelQx), and Amino-methyl-phenylimidazo-pyridine (PhIP), which are mostly formed during cooking meat at high temperatures.Benzo [a]pyrene (B[a]P) is another compound found in meat cooked in extremely high temperatures-this aromatic hydrocarbon is normally found in coal tar, wood burning, or automobile exhaust fumes. According to a study, there was 36% of the MeIQx and 50% of DiMeIQx was present in the well-done barbecued steak; contrary, 20% of PhIP was present in medium-done barbecued steak. Likely because of these factors, marinating fresh lean red meat and thoroughly cooking the meat at low temperature will reduce the production of carcinogenic compounds and thereby lower the risk of colorectal cancer

CHECK YOUR PROGRESS

What are the nutritional facts about red meat?
What is the difference in the definition of red meat by USDA and as per culinary science?
What are the health risks of consuming red meat?

White meat

White meat or light meat refers to the lighter-colored meat of poultry, as contrasted with dark meat. In a more general sense, white meat may refer to any lighter-colored meat, as contrasted with red meats like beef and some types of game.

White meat is made up of fast-twitch muscle fibres, while red, or dark, meat is made up of muscles with fibres that are slow-twitch.

Pork

Given nutritional concerns, meat producers are eager to have their products considered white meat, and the United States National Pork Board has positioned their product as "Pork. The Other White Meat", alongside poultry and fish; this follows the traditional gastronomic classification. However, meats which are red when raw and turn white on cooking, like pork, are categorized by the United States Department

of Agriculture as red meats if the myoglobin level is higher than 65%, and this is the definition used in nutritional studies. This categorization is controversial as some types of fish, such as tuna, are red when raw and turn white when cooked; similarly, certain types of poultry that are sometimes grouped as "white meat" are actually red when raw, such as duck and goose. In contrast, the USDA considers all meat from mammals to be "red meat."

In Israel, where Jewish dietary laws are popularly practiced, forbidding the consumption of pork, "white meat" is the accepted euphemism for pork.

Poultry

Within poultry, there are two types of meats—white and dark. The different colors are based on the different locations and uses of the muscles. For ground-based birds like chicken and turkeys, dark meats occur in the legs, which are used to support the weight of the animals while they move. These muscles are designed to develop endurance for long-term use and contain a large amount of myoglobin, allowing the muscle to use oxygen more efficiently for aerobic respiration. In contrast the white meat, generally found within the breasts of the birds, are used for quick bursts of power which requires little of the meat-darkening myoglobin. Birds which use their chest muscles for sustained flight (such as geese and ducks) have dark meat throughout their bodies.

Dark meat contains 2.64 times more saturated fat than white meat, per gram of protein. One commentator wrote that dark meat contains more vitamins, while a New York Times columnist has stated the two meats are nearly identical in nutritional value, especially when compared with typical red meat. According to the U.S. Department of Agriculture, one ounce of boneless, skinless turkey breast contains about one gram of fat, compared with roughly two grams of fat for an ounce of boneless, skinless thigh. The numbers go up when the skin is kept in: a chicken thigh, with skin intact, has 13 grams of total fat and 3 1/2 grams of saturated fat per 3-ounce serving; this is about 20 percent of the recommended maximum daily intake.

2.17 CUTS OF MEAT

Cuts of Lamb and Mutton

Lamb is divided into large sections called primal cuts. These large cuts are then broken down further into individual retail cuts that you buy at the supermarket or butcher's shop.

Unlike beef, which is divided into sides, lamb is first divided into sections called the foresaddle and hindsaddle, which are then broken down further into their main primal cuts.

Approximate zones of the usual UK cuts of lamb:

- Scrag end (of neck)
- Middle neck
- Best End (of neck)
- Loin
- Chump (and chump chops)

- Leg (gigot in Scotland)
- Shank
- Shoulder
- Breast

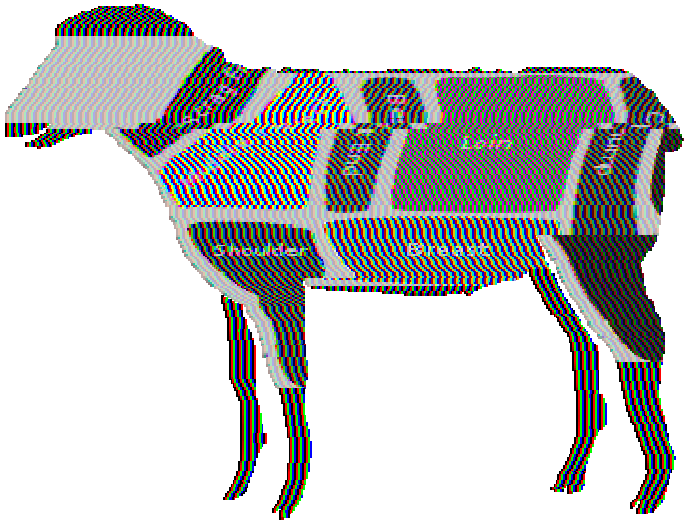


Fig 2.64: UK Cuts of Lamb or Mutton

CHECK YOUR PROGRESS

What is meant by primal cut?

List the various cuts of lamb or mutton as per British system.

2.18 MEAT STORAGE AND HANDLING

(Source: FAO: Meat and meat products in human nutrition in developing countries, UN. 1999.)

Meat was originally processed to preserve it, but since the various procedures cause so many changes in texture and flavour it is also a means of adding variety to the diet. Processing also provides scope to mix the less desirable parts of the carcass with lean meat and in addition is a means of extending meat supplies by including other foodstuffs such as cereal in the product.

Meat is a highly perishable products and soon becomes unfit to eat and possibly dangerous to health through microbial growth, chemical change and breakdown by endogenous enzymes.

These processes can be curtailed by reducing the temperature sufficiently to slow down or inhibit the growth of micro-organisms, by heating to destroy organisms and enzymes (cooking, canning), or by removal of water by drying or osmotic control (binding the water with salt or other substances so that it becomes unavailable to the organisms). It is also possible to use chemicals to inhibit growth and, very recently, ionizing radiation (however, the last is not allowed in some countries).

Traditional methods that have been used for thousands of years involve drying in wind and sun, salting and smoking. Canning dates from early in the 19th century and allows food to be stored for many years since it is sterilised and protected from recontamination.

Chilling and Freezing

While mechanical refrigeration is a modern process it is known that the ancient Romans kept food cool with ice. "Chilled" meat is usually stored at temperatures around 1°C to +4°C when it keeps well for several days. Provided that the meat is kept very cool(1°C to 0°C) and that slaughter and meat cutting are carried out under strict hygienic conditions, modern packaging techniques including storage under carbon dioxide or nitrogen or in vacuum can extend this period to about 10 weeks.

Chilling at temperatures very close to the freezing point of meat, -15°C, diminishes the dangers of most pathogens and slows the growth of spoilage organisms; growth of some organisms, moulds, virtually ceases at -10°C.

Freezing - commercially at -29°C and domestically at -18°C - is now a standard method of preserving for periods of 1-2 years but there is some deterioration of eating quality compared with fresh or chilled meat.

However, there are problems in chilling and freezing meat. If it is cooled too rapidly below 10°C before the pH of the muscle has fallen below a value of about 6, the muscle fibres contract (cold shortening) and the meat is tough when cooked. This problem applies more to small animals, such as lamb, which cool down rapidly. The modern procedure is to cool the carcass to 10-15°C ("conditioning") and to hold that temperature for a few hours until the pH has fallen to 6. Beef carcasses can be suspended in such a way as to exert a pull on certain muscles to prevent contraction. Another method is to apply electrical stimulation to the carcass after slaughter (low volt) or after evisceration (high volt) for 2-4 minutes to bring down the pH rapidly.

Another problem can arise during thawing of pre-rigor frozen meat when the muscle contracts and exudes a substantial part of its weight as tissue fluids (thaw rigor)

(Lawrie 1991). Clearly, freezing of meat is not a straightforward procedure and calls for certain expertise. Only post-rigor meat should be frozen.

Nutritional Changes by Freezing

Meat is frozen without any prior treatment, unlike vegetables which have to undergo a preliminary blanching process to destroy enzymes involving considerable loss of water-soluble nutrients. So there is little or no loss of nutrients during the freezing procedure, nor, so far as there is reliable evidence, during frozen storage - apart from vitamin E.

Proteins are unchanged during frozen storage but fats are susceptible to rancidity. Pork and poultry meat are more susceptible since they are richer in unsaturated fatty acids than other meats, and comminuted meat is also very susceptible to rancidity because of the large surface area which is accessible to oxygen.

The vitamin E is damaged because the first products of fat rancidity, hydroperoxides, are stable at the low temperature and oxidise the vitamin. At room temperature they break down to harmless peroxides, aldehydes and ketones, so that vitamin E is more stable at room temperature than during frozen storage.

The losses incurred in frozen meat mostly take place when the meat is thawed, and juices are exuded containing soluble proteins, vitamins and minerals. This is termed "dripthaw" and the amount depends on the length of time of ageing (time between slaughter and freezing), whether frozen as carcass or meat cuts, conditions of freezing and speed of thawing; it varies between 1% and 10% of the weight of the meat and is usually about 5%.

There is some loss of nutrients when the meat is cooked after thawing; results published in the scientific literature tend to measure the combined losses from the original fresh meat to the final cooked product. Unfortunately the results vary so much that it is not possible to draw conclusions.

It must be emphasised that the variations are largely due to difficulties in analysis of the B vitamins, and to differences in conditions and methodology - even results from the same laboratories are inconsistent. This is illustrated very clearly by results published from one group of investigators who examined pork loin after freezing and storage at -12°C and 24°C and subsequent cooking at regular intervals over one year for changes in thiamin, riboflavin and pyridoxine. Despite constant experimental conditions analyses at two monthly intervals showed wide fluctuations, especially for thiamin, which were attributed by the authors to difficulties in analytical methods.

It was tentatively concluded after storage at -12°C and cooking that about 90% of the thiamin was retained but no firm conclusions could be drawn about other vitamins. For riboflavin about 90% was retained at -12°C and 100% after storage at -24°C and cooking, although these results were also variable.

For pyridoxine 80% was retained when stored at -12°C and cooked but the results were erratic.

In the same report ground beef was examined only after 1 year storage and showed 80% retention of thiamine, 85% of riboflavin and 100% of pyridoxine at both temperatures.

A summary of earlier work (1975) suggested that losses during freezing and storage of meat and poultry for 6 - 12 months at -18°C but excluding subsequent cooking, ranged between zero and 30% for thiamin, riboflavin, niacin and pyridoxine. A survey of frozen meals analysed after freezing, storage and cooking reported losses of up to 85% of thiamin, 55% of vitamin A, 33% vitamin E, 25% niacin and pyridoxine (study in 1974).

Processing - General Aspects

Processed meats are products in which the properties of fresh meat have been modified by the use of procedures such as mincing, grinding or chopping, salting and curing, addition of seasonings and other food materials, and, in many instances heat treatment. Most of these processes extend the shelf life of meat. Their manufacture, in most instances, depends on the ability of the mixture to retain water since they are emulsions of protein, fat and water.

Meat Content of Processed Meats

Where there is a demand for consumer protection it is often necessary to legislate to control the meat content of products that include other food ingredients.

Even if no additives are included meat products can contain variable amounts of lean muscle tissue, fat and connective tissue. A method of assessing the apparent meat content of a raw product is by determination of the total nitrogen content on a fat-free basis and multiplying by an average conversion factor, corrections being applied for the contributions from cereals or other nitrogen-containing ingredients e.g. 3.45 for pork products, 3.55 for beef, 3.7 for chicken (3.9 for breast of chicken and 3.6 for dark meat), 3.45 for ox liver, 3.65 for pig liver (3.55 for liver of unknown origin), 2.7 for kidney, 3.2 for blood and 3.0 for tongue. There are no agreed factors for conversion of nitrogen for cooked, cured or processed meat and the apparent meat content of such

products is expressed approximately in terms of "raw meat equivalents" (Egan, Kirk and Sawyer 1981).

Other methods used for legal control purposes refer the composition of meat products directly to the nitrogen or protein content of the dry, fat-free product or to the water: nitrogen ratio. Lean meat can be determined directly by measurement of 3-methyl histidine which is characteristic of meat protein but if large amounts of fillers and binders are present the method is unreliable.

The proximate composition of some processed meat products is given in Tables 216, United Kingdom products, and 2-18, United States products; in both instances the composition is regulated so these data are not universally applicable and serve only as examples.

Curing

Curing was originally a term applied to preservation in general but is now restricted to preservation with salt (sodium chloride) and sodium or potassium nitrite or nitrate or a mixture of these two salts. The nitrate serves as a reservoir for nitrite - the active compound - since bacteria in the curing solution form it from the nitrate.

The use of salt is one of the oldest methods of preserving meat since at concentrations greater than 4% in the aqueous phase it inhibits the growth of most spoilage organisms. To function as a complete preservative the salt concentration would need to be around 17%, at which levels the product would be unpalatable. In most cured meat products the salt concentration is between 2.5 and 5% and the nitrite inhibits the growth of other organisms. Nitrite also reacts with proteins when heated to form compounds (called Perigotype factors) that inhibit the development of spores of Clostridium botulinum, the cause of botulism, the most serious type of food poisoning.

Additionally, nitrite is broken down to nitric oxide, which reacts with the red colouring matter in muscle, myoglobin to form deep-red nitrosomyoglobin. As the protein is denatured, this is converted, rapidly when heated and more slowly otherwise, into a pink compound which is responsible for the typical colour of cooked ham, canned luncheon meat, franfurters and raw ham, dry sausage, etc.

The early curing procedures were lengthy and recent developments have led to a reduction in the time required. For example instead of simply immersing the meat in brine it is first injected with the curing solution and the process can be completed in 1 - 2 weeks. Thin slices of meat such as bacon can be cured in a few hours, and the

processing time can be reduced to a few minutes if heated and if the cure is completed in the final package.

Animal experiments have shown potential risk from nitrosamines formed from nitrite but, the amounts present do not appear to be harmful to human beings.

The addition of sodium ascorbate to the pickling brine accelerates the curing process because of its reducing capacity and allows smaller amounts of nitrite to be used, so there is less residual nitrite in the meat which reduces the possibilities of the formation of nitrosamines. Residual ascorbic acid has an antioxidant effect in stabilising the colour and preventing rancidity.

Tumbling and Massaging

A new technique was developed in the 1960's to accelerate the penetration of salt. Pieces of meat are injected with the curing salt solution or chopped meat immersed in it and then mechanically shaken - "tumbled". Solutions of 2-8% salt are used, sometimes with the addition of polyphosphate, when there is some extraction of water-soluble protein, mainly myosin. The effect is to improve the water-holding capacity of the meat by reaction between the salt and the structural proteins, aided by the polyphosphate. The extracted proteins set to a strong gel on heating and so bind together the pieces of meat, which can then be shaped or sliced.

The term "massaging" is applied to a relatively gentle mechanical treatment while "tumbling" is a more vigorous action.

Smoking

Meat has been treated with smoke from the earliest days - traditionally over a wood fire and more recently by producing smoke from wood sawdust in a generator and conducting the smoke over the meat.

The substances deposited on the meat contribute to the flavour and appearance but with ordinary, light smoking the preservative effect is limited and the product has to be stored refrigerated.

Intensive smoking does prolong shelf life both by heavier deposition of preservatives and by the drying effect of the hot air but it has a detrimental effect on flavour. Consequently preservation by smoking is regarded as an emergency measure when other methods cannot be used.

A modern development making use of the flavouring effect is to use an aqueous solution of the constituents of smoke which reduces the amount of strongly flavoured and other unwanted substances.

Processed meat products

Common Cured Meat Products

The commonest cured products are sausages, bacon, pork shoulder, ham, luncheon meat; any type of meat can be cured either as whole cuts or after comminution.

Bacon is cured pork, in various countries traditionally made from specified parts of the pig but it can be made from any part. There are modifications of the process including so called sweet cure with added sugar (0.25%) and mild cure with less salt.

Bacon can vary greatly in the amount of fat and there are considerable differences between the various published figures; those shown in Table 2-16 are from the same source and so are comparable with one another.

Ham is the cured product of the upper leg and buttock of the pig and differs from gammon only in that the latter is cut from the side of bacon after it has been cured. It is stable when raw after a certain period of maturation but is often cooked to pasteurisation temperature, 70°C, or it may be canned at pasteurising temperature. It may be smoked as an additional means of preservation and flavouring.

Typical analysis of canned ham per 100 g: 65-72 g water, 18 g protein, 5-12 g fat, 0.5-0.8 MJ, 1100-1250 mg sodium, 1.2-2.7 mg iron, 0.2 mg copper, 2 mg zinc, 0.5 mg thiamin, 0.2-0.25 mg riboflavin, 4 mg niacin, 0.2 mg vitamin B6, and may have residual ascorbic acid 10-60 ma.

Sausages

There are some 800 types of sausage made of comminuted or chopped meat of various kinds, seasoned with salt and spices, often mixed with cereal and packed into natural casings (consisting of the connective and muscle tissue of animal intestines) or made of cellulose, collagen or synthetic materials. There are six main types of sausage - fresh, smoked, cooked, smoked and cooked, semi-dry and dry.

Frankfurters, Bologna, Polish and Berliner sausages are generally made from beef, pork and pork fat comminuted with the addition of curing salts and are smoked and cooked. Thuringer, soft salami, mortadella, and soft cervelat are cooked and semi-dry;

pepperoni, chorizos, dry salami and dry cervelat are slowly dried to a hard texture without cooking.

CHECK YOUR PROGRESS

Which are the various methods of preserving meat?
What is curing?
Descrine some of the product which use curing as preservation method?

2.19 SUMMARY

In this unit we studied the various types of non-vegetarian foods. We began with eggs. The eggs of hen, duck, ostrich and fish (caviar) are used as food item. We studied the culinary use of egg. The egg yolk is used as thickening agent and as emulsifier in cooking. We studied structure of egg. We saw that egg comprises of fifteen parts including egg shell, cuticula, chalaza, germinal disk, outer membrane, inner membrane, exterior albumin, middle albumin, vitelline membrane, nucleus of pander, air cell, yellow yolk, white and internal albumin, . We also saw that if the air cell is more in volume the quality of egg is poorer. (A very old egg will actually float in the water and should not be eaten). The eggs are classified according to their sizes. In US they are graded as AA, A, B, etc. They are also graded as jumbo, XL, L, M, S and peewee (in decreasing order of size). We saw that there are around six varieties by quality of egg including omega 6, nest-laid, cage-free, free-run, free-range and organic. We studied the health conditions which should be maintained for selecting good quality eggs. Laying hens are often slaughtered between 100 and 130 weeks of age, when their egg productivity starts to decline. We learned how to preserve eggs. A century egg or hundred-year-old egg is preserved by coating an egg in a mixture of clay, wood ash, salt, lime, and rice straw for several weeks to several months, depending on the method of processing. We studied how omelet can be prepared in five varieties: classic filled omelette, a plain French omelette, a steamed omelette, and a baked omelette.

We studied the birds which are used as food, including chicken. Poultry are domesticated birds kept by humans for the eggs they produce, their meat, their feathers, or sometimes as pets. **Game** or **quarry** is any animal hunted for sport or for food. The edible components of chicken mainly include breast, leg and wing. We saw various breeds of chicken in India. There are only four pure Indian breeds of chicken available: aseel, Chittagong, Kadaknath and Busra**.** Various breeds developed by various government agencies have also been studied. We studied various cuts of poultry as defined by United States Department of Agriculture (USDA). The yield of actual edible part of poultry in comparison to the total product purchase has also been studied. As per a study by Texas A&M University, 70% yield in term of raw meat and skin is obtained when you purchase whole bird. Such information can be used to calculate the cost per kg for meat which is actually eaten. We also studied recipe of two chicken dishes in this Unit: Chicken Tandoori Paratha and Butter Chicken.

We studied meat from mammals in the later sections of the unit. We see that there are three types of meat called bovine (from cattle), ovine (from sheep) and swine (from pigs). The pork is the most popular variety by consumption. The meat is classified by color as red meat and white meat. Beef is classified as

red while poultry and pork is classified as white by most culinary standards. However, USDA defines all meat from mammals as red due to predominance of protein myoglobin. In 2015 the International Agency for Research on Cancer concluded that processed meat is definitely carcinogenic (Group 1) and found that for each additional 50g of processed meat consumed per day, the risk of colorectal cancer increased by 18% (up to a maximum of approximately 140g); it also found that there appeared to be an increase in gastric cancer but this was not as clear. We have studied the cuts of lamb. The Lamb is divided into large sections called primal cuts. These large cuts are then broken down further into individual retail cuts that you buy at the supermarket or butcher's shop. The approximate zones of cuts as per UK system includes: Scrag end (of neck), Middle neck, Best End (of neck), Loin, Chump (and chump chops), Leg (gigot in Scotland), Shank, Shoulder, Breast. Finally we studied how meat is stored and preserved. A number of techniques are discussed in this unit including tumbling, smoking, curing and chilling. We study effect of these techniques on the nutritional aspects. The commonest cured products are sausages, bacon, pork shoulder, ham, luncheon meat; any type of meat can be cured either as whole cuts or after comminution.

These concepts are extremely important in your development as a professional as they equip you with the necessary knowledge about egg, meat, poultry and game. These would help you to understerstand the processes of food preparation, storage and preservation as well as health issues and nutritional aspects.

2.20 END QUESTIONS

The following questions should help you prepare for the End Examinations. These questions are for 5 marks each and should take you 11 minutes under examination conditions.

1. Describe the culinary uses of egg
2. Explain the structure of egg
3. Describe ways to classify eggs
4. Explain how eggs are graded by size and quality.
5. Describe importance of iiving conditions of the birds in selecting the eggs
6. Explain how eggs are stored
7. Describe some of the dishes prepared with eggs
8. Describe the concept of poultry and games
9. Explain how the poultry are classified
10. Explain the various cuts of poultry.
11. Describe the yield of poultry and recipes of some Indian dishes
12. Explain the characteristics of meat.
13. Explain the classification of meat as bovine, ovine and swines
14. Explain the categorization of meat as red and white meat.
15. Explain the various cuts of meat.
16. Describe how meat is cured.

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UNIT 3 FISHES IN COOKING

Program Name: V101:BSc (HTS) 2016 pattern, V102: BSc(HSCS) 2016 Pattern

Course Name: HTS201: Food Production Foundation –II

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Structure:

3.00 BEFORE WE BEGIN

In this unit we will be studying Fish and Seafood. Fish are very healthy source of nutrition as they provide the right mix of poly-saturated, unsaturated and mono-saturated fatty acids. Fish provides a good source of high quality protein and contains many vitamins and minerals. They are source of food for people living near river and coastal area. Fish are classified as Freshwater Fish (like catfish, Grayling, Pickerel, Pike, Rainbow Trout, Sunfish, Tilapia, Trout, Walleye Pike, Whitefish, Zander) and migratory fish which mature in saltwater and migrate to freshwater to spawn (like Eel, Salmon, Shad, Smelt, Rockfish, Sturgeon) and Saltwater Fish (like Tuna, Weakfish, etc). We will study some rules while purchasing fish. We study how to preserve and store fish. Storing considerations include contamination prevention (cleanliness, using different platter and cooking utensils for cooking fish than what was used for raw fish, etc), handling fisherman's catch (keeping fish alive till done fishing, keeping temperature of fish below 40F, etc) Cooking safety, Deep Frying safety, Checking temperature of oil, Storage considerations, Refrigeration, handling cooked fish leftover, Freezing, Double Wrapping, Freezing in a block of ice, glazing, freezing cooked fish leftover, fish consumption safely,

Shellfish is a culinary and fisheries term for exoskeleton-bearing aquatic invertebrates used as food, including various species of molluscs, crustaceans, and echinoderms. Although most kinds of shellfish are harvested from saltwater environments, some kinds are found in freshwater. Shellfish is a common part of indigenous cuisines throughout the globe. Some popular dishes using shellfish: Ceviche, Cioppino,

Callaloo, Clam chowder, Curanto, Fruits de mer, Paella, Sashimi, Shrimp cocktail, Lobster bisque, She-crab soup, Sliced fish soup, Sushi, Shrimp Saganaki, etc.

Fish and shellfish can be classified as finfish (freshwater), Saltwater fish, Shellfish and mollusks.

There are about fifteen type of fish cuts which we study: Butterfly fillet, Cheeks, Cutlets, Darnes, Fillets, Gourjons, Loins, Pan-dressed, paves, steaks, Supremes, tails, Tronçons, whole and wing.

We also study popular species of fish according to a matrix of texture (delicate, medium, firm) and flavor (mild, moderate and full).

We study some popular recipe like batter fried fish, fish korma and maccher jhol (fish in Bengali sauce). Fish can be cooked using grilling, baking, poaching and shallow frying. We discuss the specific tips while using these techniques.

As fish is a very important food item and needs very careful handling, it is essential for a hospitality professional to understand these issues thoroughly. We are sure you will study this unit with due sincerity.

3.01 UNIT OBJECTIVES

After studying this unit you will be able to

- Describe the importance of fish in cooking
- Explain the various types of fishes
- Describe ways to store fish
- Explain what is meant by fish and shellfish
- Describe various cuts of fish
- Explain popular species of fish
- Describe the preparation of dishes of fish
- Describe common cooking methods of sea food

3.02 FISHES IN COOKING

A fish is a cold-blooded, backboned, aquatic animal and there are many types of fish that live in every region of the world. Fish are harvested for their highly nutritious meat and for the oil that is extracted and used as a food product or as an ingredient for a wide variety of commercially prepared products. Fish are consumed as food by many species, including humans. It has been an important source of protein and other nutrients for humans throughout recorded history.

Fig 3.01: Redbelly tilapia presented as food

In culinary and fishery contexts, the term fish can also include shellfish, such as molluscs, crustaceans and echinoderms. English does not distinguish between fish as an animal and the food prepared from it, as it does with pig vs. pork or cow vs. beef. Some other languages do, as in the Spanish peces versus pescado. The modern English word for fish comes from the Old English word fisc (plural: fiscas) which was pronounced as it is today. English also has the term seafood, which covers fish found in the seas and oceans as well as other marine life used as food.

Nutritional Aspects

Fish provides a good source of high quality protein and contains many vitamins and minerals. It may be classed as either whitefish, oily fish, or shellfish. Whitefish, such as haddock and seer, contain very little fat (usually less than 1%) whereas oily fish, such as sardines, contain between 10-25%. The latter, as a result of its high fat content, contain a range of fat-soluble vitamins (A, D, E and K) and essential fatty acids, all of which are vital for the healthy functioning of the body.

Comparison of nutrients in 100 g of whitefish or oily fish

Nutrient	Whitefish Alaska pollock[4]	Oily fish Atlantic herring[5]
Energy (kcal)	111	203
Protein (g)	23	23
Fat (g)	1	12
Cholesterol (mg)	86	77
Vitamin B-12 (µg)	4	13
Phosphorus (mg)	267	303
Selenium (µg)	44	47
Omega-3 (mg)	509	2014

Halibut fillet (a whitefish) on top of a salmon fillet (an oily fish)

Fig 3.02: Fish is an important food from nutritional point

CHECK YOUR PROGRESS

What is importance of fish as a source of nutrients?
What are the various types of fish?

3.03 TYPES OF FISHES

There are numerous fresh water and salt-water fish species that are harvested throughout the world. Some of these species are shown below.

Freshwater Fish	
Fish Type	**Description**
Catfish	A type of scaleless, freshwater river fish distinguished by the whisker-like barbels that extend from its mouth. It is very popular because of its mild taste and because of the limited number of bones. It is easily poached, baked or fried.
Grayling	A small freshwater fish that is similar to a brown trout. It has an excellent flavor, but they are hard to find in most food stores and fish markets. The average weight is about one pound or less, but some may be double that. The grayling does not keep very well after it is caught, so it must be eaten as soon as possible. It is best when broiled or grilled.
Pickerel	A fresh water fish in the pike family of fish. It is the smallest of the pike family, ranging from two to three pounds. It is a lean, low-fat fish with firm white flesh when cooked.
Pike	A fresh water fish that is found in the Great Lakes and other large lakes in the upper United States and Canada. It is a family of fish, which includes the pickerel, pike and muskellunge. The pickerel is the smallest, averaging 1 1/2 to 3 pounds, the pike ranging

	form 3 to 10 pounds, and the large muskellunge, generally referred to as muskie, ranging from 10 to 35 pounds. Muskellunges have gotten as big as 60 pounds. The pike is known for its lean, low fat, firm flesh, which is yellow when raw but flaky white when cooked. One disadvantage of the pike is that it is bony. Pike is available fresh or frozen, and whole or in fillets or steaks. Pike can be prepared by most any cooking method.
Rainbow Trout	A freshwater fish with a firm textured flesh that has medium to high fat content. It is one of the most popular varieties of trout throughout the world. Most commercially raised Rainbow trout average 8 ounces but they can grow up to 50 pounds. Rainbow trout can be found fresh and frozen, whole and in fillets, and is generally fried when cooked. They can also be grilled, broiled, baked, steamed and poached.
Sunfish	A North American freshwater fish, which consists of many varieties that are noted for their unique shapes and brilliant colors. The varieties include white and black crappies, and several types of bass, such as largemouth, smallmouth, redeye, rock, and spotted.
Tilapia 	A name used to refer to several species of warm, freshwater fish that are commonly bred in commercial operations to be processed for food. Although, Tilapia is a freshwater fish, it is also found living in saltwater. They cannot survive in water less than 60°F. Tilapia grown in warmer waters will often reach a weight of 3 to 4 pounds, while the majority produced for food in commercial ponds will weigh approximately 2 pounds or more. Since they reproduce well and can be raised in controlled ponds, they can be processed faster, brought to market quicker and provide fresher meat than other varieties that require longer harvesting, processing and distribution time. While the outer flesh may range in color from black with white shading to pinkish-red, the meat of this fish is white, firm in texture and mildly sweet in flavor, very similar to

	catfish. It can be prepared by baking, broiling, grilling, frying, poaching, or steaming.
Trout 	A round freshwater fish, which is found worldwide. There are several varieties of trout, including rainbow, brook, and lake. Rainbow trout, known for the pinkish red stripe on its sides, is the most popular variety with American consumers. The flesh of trout ranges from white to pink or orange in color and has a mildly rich taste and a tender, flaky texture. Trout is moderately lean and can be prepared by frying, broiling, grilling, or baking. It can be found fresh or frozen and is most often sold whole. If not available, salmon or whitefish can be substituted.
Walleye Pike 	A type of freshwater fish that is not a pike at all, but is a member of the perch family. Walleyed Pike has firm, flaky flesh that is mildly flavored and is suitable for many cooking methods including baking, frying, broiling, grilling, and poaching. It is found mainly in freshwater lakes of the northern United States and adjoining areas of Canada.
Whitefish  Whitefish Filets	A type of fish related to the salmon that is found in bodies of fresh water in North America. The flesh has a mild flavor, but it has a high fat content. Whitefish is suitable for baking, frying, grilling, broiling, and poaching.
Zander	A species of fish living in slow flowing rivers, lakes and ponds, which are sought as both a sport and food fish. Although the Zander may grow to a weight of over 20 pounds and is prized as a good fighting fish, it is generally caught for use as a food source ranging in weight from 4 to 8 pounds. Similar in appearance and flavor to a Walleye, the Zander provides a firm white

	meat that flakes nicely when cooked. Most common in Europe where it is also known as the Pikeperch, this fish is often baked, fried or grilled and then served as a main dish or as a meat ingredient for salads.

Migratory Fish

Migratory fish mature in salt water but migrate to fresh water to spawn.

Fish Type	**Description**
Eel	A type of fish that is characterized by a smooth, snakelike body. They are found in fresh water rivers and lakes in Europe and North America, but migrate to the southwestern Atlantic for spawning. The flavorful meat of the eel is popular in Europe and is especially popular in Japan and other Asian countries. It is not as popular in the United States even though it was a favorite among people during colonial times.
Salmon  Salmon Filets	An anadromous fish, which means that the fish was born in freshwater, then migrates to saltwater to mature and then returns to freshwater to spawn. Popular to serve as a main dish, Salmon provides a tender, flaky-textured meat with a mild to rich flavor, depending on the species. It is a fish that is rich in omega-3 fatty acids, which help to reduce LDL (bad) cholesterol. Salmon can be prepared in most any manner, such as smoked, baked, broiled, grilled, fried, or poached. Salmon originated in the Atlantic and Pacific Oceans but are now grown in most locations where there is cold, protected seawater.
Shad	The largest member of the herring family, it has a slight oiliness to it and a mildly sweet flavor that resembles pompano and salmon. Shad is an anadromous fish, which means that it is born in freshwater and then migrates to saltwater to mature

	and then returns to freshwater to spawn. This fish is hard to fillet because of its many small bones so it may be desirable to purchase it already filleted, otherwise, it can be steamed or baked at a low temperature for more than six hours, until the bones disintegrate. Female shad is more in demand than male because they are fatter and larger, and because they contain the desired roe.
Smelt	An anadromous fish, meaning it matures in saltwater but migrates to freshwater to spawn. It is a very small silver colored fish, which has a tint of green coloring on its back. The best season for smelt generally starts in September and runs into May. They are generally found ranging in size over 3 inches to under 8 inches. Smelt are sold, cooked and eaten whole. They have a rich, oily flesh with a mild flavor. They are highly perishable so if they are not to be eaten immediately after they are caught, they are quickly frozen.
Striped Bass (Rockfish)	A lean saltwater fish with flesh that is tender, white, and mildly sweet. The striped bass is a saltwater fish that migrates to fresh water to spawn. It is a versatile fish that can be prepared in many ways, but when grilling, it is best to place the fish in a fish basket because it does not hold together well. Trout, grouper, snapper, or monkfish can be used for substitutes if striped bass is not available. Striped bass is also known as "rockfish."
Sturgeon	An anadromous fish, meaning it matures in saltwater, but migrates to fresh water to spawn. It averages in weight at 55 to 60 pounds, but some specimens grow much larger. The fish roe from the sturgeon is considered the "true caviar" and is probably more important than its flesh. The sturgeon has a rich, high fat flesh that is very firm, similar to meat, and is delicately flavored. On a limited basis, fresh sturgeon is available whole (less than eight pounds), or cut into steaks or chunks. Most of the sturgeon caught in U.S. waters is smoked.

Saltwater Fish	
Fish Type	**Description**
Ahi (Yellowfin Tuna)  Ahi (Yellowfin Tuna) Steak	The Hawaiian term for one of the types of tuna that has a light pink flesh and a slightly strong flavor. It is a very popular fish in Hawaii and Japan where it is often eaten raw. This fish is also known as yellowfin or bigeye tuna.
Alaska Pollock	A saltwater fish that is a member of the cod family and sometimes referred to as bigeye pollock or walleye pollock. It has a slender body that is olive green to brownish in color on its back and its sides are silvery. Its flesh is firm and white which flakes nice when cooked. The Alaska Pollock should not be confused with the Atlantic Pollock, which is more oily with a darker flesh that has a fishier taste. Alaska Pollock is great for baking, broiling, sautéing, frying, steaming, or poaching. It is the most widely used fish in the fast food market where it is used to make fish n' chip fillets, fish patties for sandwiches, and ground fish products. Alaska Pollock fillets are also delicious enough to be served in a nice restaurant. A large quantity of the Alaska Pollock that is harvested today is the used to make surimi, which is imitation seafood.
Albacore Tuna	A variety of tuna that is very flavorful and has the lightest colored flesh of all the different species of tuna. It is generally more expensive than other varieties and the canned version is often called "white tuna." The meat is tender and flaky when cooked and like all tuna, it is fairly high in fat content.
Anchovy	A small saltwater fish belonging to the herring family that is native to the Mediterranean Sea and the English

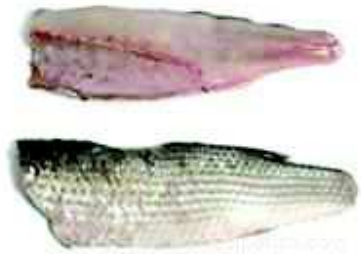
 Anchovies  White Anchovies	Channel. Typically no more than 6 inches in length, the anchovy is green colored as a fresh fish, but changes to a grayish black color when cured. Similar to a sardine in size, this fish is used often in the same way as a sardine, being served in appetizers or as an ingredient to season and garnish a variety of foods, such as salads, soups, pasta, or pizza. Anchovies are processed into filets and preserved by curing them in salt and packing in olive oil, by pickling the filets in vinegar and oil (referred to as "boquerones" in Spain), or by preserving the filets as fresh fish. When cured, they become dark black in color and salty in flavor. Anchovies packed fresh in oil (olive or sunflower) and wine vinegar are referred to as white anchovies, retaining more of their white silvery color. White anchovies are fresher in age, more perishable and may not last long after being purchased. The white anchovy filets however, provide less of the salty taste present with salt cured anchovies.
Cod	A common type of saltwater fish that has flaky white meat and a mild taste. It is one of the most popular types of fish and is used in many processed fish products, such as fish sticks or fish cakes. It is also a variety of fish that is often blended with other types of white fish to produce the fish stick products or other food items containing fish. Haddock and hake make good substitutions for cod.
Flounder 	A saltwater fish that has flaky white flesh when cooked and a mild flavor. It is one of the varieties of flatfish that are characterized by their flat oval bodies, horizontal swimming style, and eyes that are on one side of their head. If flounder is not available, other flatfish varieties including sole, halibut, dabs, and plaices can be substituted.
Fluke  Fluke - Front	A type of flatfish that is a member of the flounder family. The skin on the top side is grayish brown to black with the underside white, typical of flatfish which lay on their underside and have two eyes on their top side or left side when considered in a vertical, rather than flat position. Ranging in size from 3 to 5 pounds, fluke is available as a whole fresh fish or in fillets. The fillets will weigh from several ounces to a pound each, with the skin removed. The meat is white and can be broiled or baked.

 Fluke - Back	The fillet meat on the topside or dark side is always thicker than the meat on the bottom side or light side. The flesh is smooth, white and firm in texture, which cooks nicely and flakes easily. The fluke is also known as a summer flounder, a flattie, and a lefteye flounder. A similar type of fish from the same family is the winter flounder that is considered a right-eyed fish. Like the fluke, this fish has similar textured meat that is flavorful and good for baking or broiling.
Flying Fish	An ocean fish that commonly jumps out of the water and glides airborne over the surface for a distance of 10 to 20 feet. Small in size (12 to 15 inches generally), the Flying Fish has large oversized pectoral fins and a split tail with a larger surface area on the lower tail section than on the upper tail section. Some species have both large pectoral fins and smaller pelvic fins that serve to enable longer gliding distances. The meat of the Flying Fish is firm, tender and white in color, providing a good tasting meat that can be baked, fried, grilled, steamed, or served in stews. It is best to eat Flying Fish soon after they have been caught, since they do not keep well for shipping long distances.
Grouper 	A fish found in the warm waters of the Atlantic, Gulf of Mexico, and Caribbean, belonging to the sea bass family. They may weigh as much as several hundred pounds, but the average weight caught for commercial use is 15 pounds or less. Grouper have a firm white flesh when cooked and are suitable for boiling, poaching, or baking. The strong tasting skin should be removed before the fish is cooked.
Haddock	A white fish found in the colder waters of northern oceans that is very much like cod, but is smaller. It may be used in any other recipe that calls for white fish such as cod or flounder. Haddock can be used in recipes that require the fish to be fried, baked, poached, or broiled.
Halibut	A saltwater whitefish that has, mildly flavored, flaky flesh. The most desirable halibut with the best flavor usually weigh less than 10 pounds. Halibut is a member of the flatfish family and can be used as a substitution in recipes that require other types of flatfish such as flounder and sole.

Hapuka Grouper	A member of the Grouper family of ocean fish, Hapuka is large fish that reaches 4 to 5 feet in length. Thick-bodied, the Hapuka has an outer skin that can vary from silver and blue to a pink, brown and silver combination. Most often found in deep waters, this fish is common in the waters around New Zealand and Australia. Filets from the Hapuka are firm, white, very flavorful, and somewhat similar to a bass. The Hapuka may also be referred to as a Hapuku or a New Zealand grouper.
Herring  Herring Filets	A type of saltwater fish found in the colder waters of the North Atlantic. There are many varieties of herring and most of them grow to no more than a foot in length. They are sold fresh, smoked, packed in salt, or pickled.
John Dory	A fish with delicious, mildly flavored meat that is native to Europe. The excellent flavor and texture of the John Dory are in direct opposition to its appearance. It has a flat, curved shaped body and an unusual looking head that is large and spiny. Pan-frying, baking, broiling, and grilling are some of the cooking methods used to prepare the fish.
Kingfish, Mackerel	A variety of the mackerel fish family, which are members of the tuna family. It is most often found in warmer ocean waters, such as from the Carolina coast in the U.S. to Brazil in South America. This fish is favored as a game fish, because of its fight and size that may range up to 100 pounds. Similar to other species of Mackerel, this fish has an oily, soft, pale flesh, that is sometimes pink, which when cooked, becomes flaky and firm with an off-white color. The rich flavor will vary according to the oiliness of the fish, which changes with the seasons and with different species, but the flavor is often compared to the Atlantic mackerel. Steaks or fillets of mackerel are available fresh or frozen and can be substituted with tuna, marlin, or swordfish in many cases. This species may also be referred to as king mackerels or kings. This type of mackerel is often confused with another species named Kingfish, which is

	a member of the drum family of fish. There is a southern kingfish and a northern kingfish, both drum species, which are not related to the tuna or mackerel family.
Lingcod	A saltwater game fish from the North Pacific. The lingcod has lean, flaky white meat that is mild flavored and is available in fresh or frozen fillets. To check the fish for doneness, use the tip of a sharp knife and cut through the thickest part of the fillet. If the fish has been properly cooked, the meat will appear opaque but will still be moist.
Mackerel 	A saltwater fish, related to the tuna, with an oily, soft, pale flesh, that is sometimes pink, which when cooked, becomes flaky and firm with an off-white color. The rich flavor will vary according to the oiliness of the fish, which varies with the seasons and with different species. Steaks or fillets of mackerel are available fresh or frozen and can be substituted with tuna, marlin, or swordfish in many cases.
Mahi Mahi (Dolphin Fish)  Mahi Mahi Filets	A warm water fish that has a medium textured dark flesh that turns brown when cooked. It has a good flavored flesh, but it is high in fat content. Mahi Mahi is easy to prepare by grilling or broiling and is a good alternative to swordfish. To check the fish for doneness, use the tip of a sharp knife and cut through the thickest part of the fillet. If the fish has been properly cooked, the meat will appear opaque but will still be moist. This fish is also known as Dorado (the Spanish name) or Dolphinfish.
Mako Shark	One of the many species of shark, it is found in the moderate and tropical waters of the Atlantic and Pacific oceans and can grow to be 1000 pounds within a period of five to six years. Mako sharks must be bleed out immediately after catching and put on ice. The shark's blood contains urea, which breaks down to ammonia after the fish dies. This can give the shark meat an ammonia taste and smell. Mako shark is a fairly inexpensive fish with ivory-pink meat that has a dense texture, a mild flavor and contains a moderate amount of

 Mako Shark Steaks	fat. Often compared to swordfish, its flavor is enhanced with the addition of spicy flavoring when cooking. If not available, most recipes can have the Mako shark substituted with a meaty fish, such as tuna, catfish, marlin and swordfish. When selecting Mako shark, smell the fish first to determine if there is an aroma of ammonia. If the ammonia smell is slight, the meat should be alright, but if it has a strong ammonia aroma, the fish should not be purchased. A slight ammonia smell can be eliminated by soaking the fish in an acidic solution of water and lemon juice or vinegar. Cover the fish with cold water and add 1/2 teaspoon of lemon juice or one tablespoon of vinegar for each pound of shark you are soaking. Allow the shark to soak in the refrigerator for at least 4 hours. When the ammonia smell is strong, it is an indication that the shark was not properly handle when first caught, has not been properly stored, or that it is no longer fresh. Soaking the shark at this point will not eliminate the ammonia smell or taste.
Monkfish 	A strange-looking fish that is firm textured and has delicious tasting meat, similar to that of lobster. In Europe, the monkfish has been treasured for many years, but until the later part of the 1970's, American fisherman would dispose of the monkfish. Americans now keep the monkfish, but only for the meat from the tail, whereas Europeans use the entire fish. It can be prepared using several different cooking methods, such as poaching, roasting, sautéing, or grilling. If monkfish is not available, it may be substituted with grouper, tilefish, or lobster. When cleaning, be sure the fish is thoroughly skinned, paying particular attention to the center ridge. Skin remaining on the ridge will cause the fish to be tough when cooked.
Mullet 	A firm textured fish that has both white and dark meat which provides a somewhat nutty flavor. One of the most popular species for food dishes are the striped or silver mullets. In the Southern U.S., the flesh and roe of the mullet are both very popular, but most of the roe harvested in the U.S. goes to Taiwan and the Middle East. As with most fish, mullet can be baked, broiled, grilled, fried, and poached.

 Mullet Filets	
Ocean Perch **(Rosefish, Redfish)**	A type of rockfish found along the North Atlantic coasts of North America and Europe. Their coloring is a bright orange-red and they can weigh up to 5 pounds but are most often 1 1/2 to 2 pounds when caught for market. Its flesh has a mild sweet flavor and medium firm texture. The larger Ocean Perch have a coarser texture. Generally ocean perch are quite tender and can be used in any recipe that calls for a white fleshed fish. Ocean Perch is also referred to as Rosefish or Redfish. It should not be confused with the Redfish found in the Gulf of Mexico, which are a member of the drum family.
Opakapaka (Pink Snapper)	A variety of fish that is common to the Pacific Ocean, most notably the Hawaiian Islands. Opakapaka, also referred to as opaka-paka, pink snapper or crimson snapper, is a fish with a light brown outer skin and a light pink colored flesh that is firm in texture. Generally, the fish is available from 1 to 10 pounds in weight and is prepared whole or filleted. It can be steamed, baked, grilled, sautéed, or poached providing a delicate and sweet flavor.
Orange Roughy  Orange Roughy Filets	A low-fat saltwater fish from New Zealand and Australia that has a white flesh with a firm, moist texture and a mild sweet taste. Orange roughy can be prepared by baking, steaming, broiling, frying or poaching.

Porgy (Scup)	A lean fish with a coarse texture and delicate flavor, consisting of a large family of fish found in temperate and tropical waters all over the world. Porgy has a lot of small bones, so when selecting, it is best to buy larger specimens because they have a better meat to bone ratio, making the bones easier to remove. Also known as sea bream or scup.
Redfish (Red Drum)	A low-fat fish that is a member of the drum family, found along the southeastern coast of the United States and in the Gulf of Mexico. Smaller redfish, weighing less than ten pounds, have a sweet, mild flavor and a moist flaky texture. Larger fish have a tendency to have a coarser flesh. This fish is also known as red drum, channel bass, spottail bass, red bass and puppy drum. If redfish is not available, other members of the drum family can most often be used, such as black drum, or weakfish.
Red Mullet	A fish that is not actually a mullet but a member of the goatfish family. It has mild flavored, firm white meat and few bones. Characteristic of other goatfish, the red mullet has long chin barbels that look like the whiskers on a goat, which they use to locate food. Sea bass or trout can be used as a substitution for red mullet.
Red Snapper 	A lean, round saltwater fish with flaky white flesh which has a firm, moist texture and a mild, sweet flavor. It can be prepared by broiling, baking, steaming or poaching. Halibut, trout or whitefish may be used as a substitution in most recipes.
Rock Cod	A lean saltwater fish that has a white flaky flesh and a mild taste. It is available in fresh or frozen fillets.
Sardine 	A small, young, saltwater fish with soft edible bones, found in the Mediterranean. There is other small, young saltwater fish found that are called sardines but they are not true sardines, such as the Pacific and Atlantic herring, blueback herring and sprat. The sardine is a silver color and has a rich flavored flesh that is dark colored. Fresh sardines should be put on ice immediately and eaten as soon as possible, but in the United States they are hard to find fresh. They are

	generally found canned in olive oil, soy oil or water. Sardines are popular as an appetizer and are good broiled or grilled.
Scrod  Scrod Filets	A young codfish, which is a round saltwater fish. Its meat has a tender, flaky texture with a mild flavor. Scrod can be prepared using several methods, such as baking, steaming, broiling and poaching. If scrod is not available, substitute halibut or haddock.
Sea Trout	A round saltwater fish that is moderately lean and has a moist, flaky textured flesh. It has a sweet, mild flavor and can be broiled, baked or fried. Sea trout is also known as "weakfish" and can be substituted by cod, haddock or bluefish if necessary.
Sheepshead Porgy	A fish that is a member of the porgy family, which is only found in the Atlantic Ocean. Its profile and teeth structure resemble that of a sheep. The flesh of this porgy has a firm, flaky texture with a sweet flavor. The sheepshead porgy is no relation to the sheepshead found in the Pacific Ocean or the freshwater drum, which is known as sheepshead. Tilefish or black drum can be used as a substitute for sheepshead porgy.
Skate	A saltwater fish, belonging to the ray species of fish, which is found in temperate waters throughout the world. It is part of the ray family and is related to the shark. Skate has a flat body with triangle-shaped wings on each side of its body. The wings, which are the pectoral fins, are the edible, boneless meat of the fish. Mildly sweet in flavor, the meat is semi-firm texture and although it appears to be somewhat layered or partitioned, it does hold together well when cooked or sautéed. When preparing, occasionally the skate meat will emit a smell similar to ammonia. This odor, which will not affect the meat, can be removed by soaking the meat in an acidulated water bath for a short period of time. If not available, catfish, shark (same family as skate) or sturgeon can be substituted.

Snapper	A saltwater fish that consists of many species. Some of the common species are red snapper, gray snapper, yellowtail snapper, and mutton snapper. The most popular species is the red snapper, which is known for its red eyes and dark pink skin. The red snapper has lean flesh that has a firm texture. Smaller snapper is available whole, but the larger fish are generally only available in steaks or fillets. Snapper can be prepared using almost any cooking method including frying, broiling, grilling, baking, steaming, and poaching.
Sole  Sole Filet	A saltwater fish found in the Atlantic off the U.S. and European coasts. There are five species found in the Atlantic waters near the U.S., but none are particularly good for eating. The best-known sole for eating, Dover sole, is in the Atlantic near Europe. It has lean, white flesh with a delicate flavor and firm, flaky texture. There are other edible species found in Europe, but none is as popular as the Dover sole. It is generally available in fillets, which are fresh or frozen. Sole is suitable for frying, broiling, baking, or poaching. Flounder, plaice, or whitefish can be substituted if sole is not available.
Swordfish  Swordfish Steak	A popular saltwater fish found in warm and tropical waters. The fish's upper jaw resembles a sword and is about a third of its length. They can grow to be as much as 1000 pounds but are generally caught before reaching 250 pounds. The moderately lean flesh of the swordfish may be white, orange or pink, but when cooked they all turn the same color and have the same mild flavor and meaty texture. Fresh swordfish is available from late spring through most of the summer. It is available frozen throughout the year. Swordfish is good when broiled, baked, grilled, steamed or poached.

Tilefish	A saltwater fish found in tropical or moderately temperate waters throughout the world. They feed on mollusks, crab, shrimp, and squid and can be as small as 2 pounds and as large as 50 pounds. It has white, low-fat flesh with a firm texture and a mildly rich flavor resembling lobster and codfish. Tilefish can be found fresh or frozen, and in fillets or steaks. The smaller fish are also available whole. Baking, broiling, grilling, frying, steaming, and poaching are suitable methods for cooking tilefish.
Tuna	A saltwater fish found in temperate and tropical waters worldwide. The flesh is tender and flaky with a meat like texture and is very flavorful. Some species of tuna will grow to be 1500 pounds, but fresh tuna sold at market will generally not weigh more than 150 pounds. Tuna is sold fresh or frozen, in fillets and steaks, which can be cooked by broiling, baking, steaming, or poaching. Canned tuna is commercially available, packed in water or oil.
Weakfish	A round saltwater fish that is moderately lean and has a moist, flaky textured flesh. It has a sweet, mild flavor and can be broiled, baked or fried. Weakfish is also known as "sea trout" and can be substituted by cod, haddock or bluefish if necessary.

CHECK YOUR PROGRESS

Which are the three basic variery of fish?
What kind of fish it Tuna?
What is meant by anadromous fish?

3.04 PURCHASING AND STORING CONSIDERATION

On Purchasing Fish

Here is an extract of one of the Canadian website "The Globe and Mail":

"For a country with the world's longest coastline and more than its share of rivers and lakes, Canada sure has a lot of cooks who are terrified of fish. We don't eat them much (Canadians' consumption of fish and shellfish has fallen 30 per cent in the last decade, to just over seven kilograms annually), or enjoy catching them (the number of sport fishers in Canada falls about 2 per cent every year, on average). And more than anything, we don't seem to want them in our kitchens. I can't count how many great cooks I've

met who grind their own beef or smoke whole pork shoulders over hickory wood, but go wide-eyed and silent when faced with a halibut fillet.

The problem boils down to trust. Unlike beef, pork and chicken, no two fish are the same. So you need a good fishmonger as a starting point: someone to tell you what's fresh, what tastes good and how to prepare it. And thanks in part to the spread of the supermarket fish counter – you know the ones, with the cello-wrapped Atlantic salmon steaks and the know-nothing attendants who answer every question with "everything's fresh" – nobody knows how to talk to a fishmonger any more. "People have every reason to be afraid of fish," said Keith Froggett, the executive chef at Scaramouche, a top seafood-focused restaurant in Toronto. "If you look at what's on display at most supermarket fish stands, you'd be wise to be afraid of it," he said.

We're here to change that, with 12 simple rules that'll let you find great fish and cook it right every time.

1. Start with a great fish shop. Maybe that's in a supermarket (a few of them are excellent). Chances are, however, it's not. A great fish shop has a wide selection, lots of customers and plenty of turnover. The displays aren't too pretty either, because the staff are too busy selling fish to be stacking it into perfect, multistorey pyramids. "My ideal fish store, you can hardly see the fish, because it's buried under ice," said John Bil, a seafood specialist and restaurateur who runs Ship to Shore, a seasonal restaurant on Prince Edward Island. At some places, such as La Mer, in Montreal, the entire retail space is refrigerated. That's a fish shop.

2. Great fish shops don't stink like fish. They shouldn't even particularly smell like fish. Why? Because great fish doesn't smell much like fish – at least not in an unpleasant way. "Ocean fish should smell like the ocean, and lake fish should smell like a clean lake," said Dan Donovan, a co-owner of Hooked, a fish store in Toronto. Or as Mr. Froggett put it, "If you've got to take your nose away, that's not something I'd want to eat." Remember, though, that none of this applies if the store sells salt cod, which is supposed to stink. (It's an acquired taste.)

3. The staff should be able to tell you everything you need to know, including where, how and when a fish was caught, said Steve Johansen, a Vancouver-based fisherman and the owner of Organic Ocean, a go-to source for many of Canada's top chefs. But for definitive answers on sustainability, check out the Vancouver Aquarium's oceanwise.ca. They've even got an iPhone app.

4. Prod, poke and sniff the merch. "A good fishmonger will let you touch the fish and get your nose right into it," said Mr. Donovan. Look to the gills first. Gills are moist and red when a fish is fresh, but turn brown after a couple of days, which is when many fishmongers cut the gills out. The eyes should be clear, round and raised. Fish that are getting past their prime look like they have cataracts. Fresh fish are usually (but not always) covered in clear, odour-free slime, too. "All fish have a protective layer of slime on it, mucus on it, and if it's still there, then you know that the fish is fresh," said Robert Belcham, a chef, restaurateur and seafood whiz in Vancouver. If you're just buying fillets, that's a good time to start poking. Fresh fish is firm and resilient. "You shouldn't be able to put your finger on it and have the dent stay in the flesh," said Mr. Donovan.

5. Don't be the sucker who buys the pre-marinated fish. If you were a fishmonger, would you drown your sweetest, most gorgeous, most lily-fresh fish in the sesame-ginger teriyaki sauce? Of course you

wouldn't. And while you're at it, try to avoid fish steaks also, unless you're dealing with bigger fish such as tuna. Fish steaks are popular with corner-cutting fishmongers because they're easy to cut. But they're typically full of bones, and rarely cook evenly.

6. Fish that's frozen at sea is often fresher than "fresh" fish. "Most fishermen go out for days at a time," said Mr. Belcham, "so if you get a fish that they caught on the first day, and they aren't back for eight days, that fish is eight days old before it hits the dock."

7. Oysters ship with harvest tags, which you should be able to inspect, said Mr. Bil. East Coast oysters are typically good for two weeks from harvest; West Coast up to 10 days, tops. Either way, they should be tightly closed, feel heavy and smell unimpeachably fresh. When you give a fresh, healthy oyster a squeeze, it won't leak any fluid.

8. There's fresh, and then there's freshest. "There's always something new and exciting that just came in," said John Meletakos, the owner of La Mer. To get that new and exciting fish, it helps to build a relationship with your fishmonger. But just as important, you have to be open to suggestions. Tell them what you typically like, then ask them, "What's great today?"

If, by contrast, you just walk in and say, "I need 20 ounces of cod," they're going to sell you the cod. "They'll say, 'Okay, here's cod.' And when you say, 'Is it good?' they'll go, 'Yeah, yeah, of course it's good,' " said Mr. Bil.

9. You can ask your fishmonger to scale the fish, skin it, fillet it and even pull the pin bones from the fillets (although some might charge a small fee for this last step). They'll even wrap up the bones separately for soup and give you recipes. "There's nothing wrong with being high-maintenance if you're paying top dollar," Mr. Belcham said.

10. Your fishmonger's recipes probably aren't as great as the ones in the just-released River Cottage Fish Book: The Definitive Guide to Sourcing and Cooking Sustainable Fish and Shellfish . From grilled smelt to razor clams with butter and garlic, it's one of the best and most comprehensive fish books there is. If you have a fish question, the answer's in it.

11. Fish doesn't get fresher in your refrigerator. Once you've bought it, use it. If you aren't going to get to it for more than a couple days, that's what the freezer's for.

12. Fish needs 15 minutes or so on the counter to warm up a bit, or it won't cook through to the middle. "So many people are so neurotic about fish, they keep it under ice in the refrigerator and then literally open the door and throw it on the barbecue," said Mr. Donovan. "There isn't a hope in hell of that working out."

There is no single, foolproof way to cook fish, because there is not a single type of fish. But we're going to give you one anyway. Get a pan hot and splash it with some neutral-flavoured oil, like grapeseed oil. Season a fillet with salt and pepper, then drop it, skin-side down, into the pan. For thin fillets, flip after a couple of minutes, take the pan off the heat, and let the residual heat finish the job. "If it's a thin fillet of sole or haddock or trout and you're cooking it for more than four minutes, you're wrecking it," said Mr. Bil. "Hake, or West Coast halibut, or a thick tuna steak, you might go to five minutes, maybe. But if you're cooking a fillet for more than five minutes, you're blowing it."

A metal skewer or paring knife will help you time things perfectly. Just stick the tip into the centre of the thickest part of the fish, count to five, then touch it to your bottom lip. If you like your fish cooked to medium, the skewer should be just warm; it'll be hotter for well done, or colder for rare. "If you're buying the best quality fish, there's nothing wrong with it being a little bit rare," said Mr. Belcham."

Handling and Storing Considerations

When working with fish it is essential that proper handling and storage are used to reduce the risk of food-borne illness and ensure a quality product. You cannot see the harmful bacteria on the fish so you must handle it as if it is present. Salmonella and E. coli are bacteria that can cause food-borne illness and are sometimes found on fish. Follow the guidelines below to ensure safety against food-borne illnesses when handling fish.

Contamination Prevention

Cleanliness: A clean working environment is essential in the prevention of contamination when working with fish. Be sure to wash hands thoroughly before and after handling raw fish. The work area, cutting boards, and utensils must be thoroughly cleaned with hot soapy water after being exposed and should not be used for other foods until properly cleaned. This will prevent cross contamination of bacteria from the fish to other foods.

When working with other foods at the same time as preparing and cooking fish, be sure to use different utensils for each food. Do not use the same platter for cooked fish as was used for the raw meat, unless it has been properly washed and dried before using. If any preparation of the fish is done on a cutting board, it should be thoroughly scrubbed with hot soapy water after each use and periodically cleaned with a bleach solution consisting of 1 tablespoon of bleach per gallon of water.

Handling Market Fish: Fresh or frozen fish should be purchased just before leaving the market so it is exposed to unsafe temperatures for as short a time as possible. It should be placed in a plastic bag to prevent any leakage from contaminating any other foods. Bring a cooler along to store the fish in while traveling home or pack the fish in ice. To maintain the quality of the fish, it needs to be kept at a temperature under 40°F. Do not allow the fish to set in a hot vehicle for any length of time unless stored properly. After purchasing it should be taken home and refrigerated as soon as possible.

When cooking and serving fish, the meat must be handled properly to prevent contamination. Use a different platter and cooking utensils for cooked fish than what was used for the raw fish, unless they have been properly cleaned and dried after exposure to the raw fish. Be sure the raw fish does not come in contact with foods that have already been cooked or foods that do not require cooking before being consumed, such as raw vegetables and fruit.

If taking cooked fish to be served at another location, be sure to pack the fish so it maintains the proper temperatures. If you are keeping it hot, it should maintain at least a 140°F temperature and if it is cold, it must be kept at or below 40°F.

Handling Fisherman's Catch: Keeping your daily catch safe from bacteria can be a challenge unless you are ice fishing. See the tips below for warm weather fish handling.

- Try to keep the fish alive until done fishing and ready to take them in to clean and store properly.
- If the fish cannot be kept alive, be sure to store them at a temperature below 40°F. Storing them in a cooler with plenty of ice will keep them cold you are ready to clean and store properly.

- When cleaning the fish, be careful not to contaminate the meat when removing the stomach and intestine contents. If the meat does become contaminated, wash it immediately with cold water.
- After cleaning, ice the fish down or keep cold (under 40°F) until you are ready to prepare it.
- When cooking the fish, be sure it is cooked until it reaches an internal temperature of 145°F.

Cooking Safety

It is necessary to cook the fish completely to eliminate the chance of food borne illness. The safest manner in which to check for doneness is to check the internal temperature with a meat thermometer in several locations. Internal temperature should be a minimum of 145°F when checked in the center of the thickest area of the fish. If a meat thermometer is not available, check for doneness by using a fork to check if the fish flakes easily and to see if its appearance is opaque and not translucent and raw looking.

Deep-Frying Safety

Deep-frying, also known as deep-fat frying, is a popular cooking method used for fish. It is a process of immersing food in a pan containing hot oil, which cooks the food quickly, producing a crispy surface covering a tender and moist interior. Because of the large quantity of hot oil that is used for deep-frying fish, there are some safety concerns that must be considered when using this cooking method. The safety concerns are listed below.

- For ease in handling and to prevent splashing of the oil when the fish is placed in the hot oil, it is best to use small pieces of fish.
- Any utensils and equipment that come into contact with the hot oil must be thoroughly dried first. Moisture on the utensils will cause splattering, which can be dangerous.
- The fish should also be free of moisture to minimize splattering when the fish is immersed into the hot oil.
- If cooking commercial frozen fish that is to be immersed in the oil while it is still frozen, be sure that the fish is free of ice crystals.

> **Note:** If the hot oil comes in contact with moisture it causes splattering of the oil. If an excess of moisture comes in contact with the hot oil it can cause major splattering and foaming of the oil, causing it to flow over the edges of the pan. Controlling the moisture contact with the oil is extremely important.

The hot oil should not be left unattended and children and pets should NEVER be allowed near the cooking area.

- After the cooking is completed, the oil should not be transferred to another container or disposed of until it has completely cooled. It is extremely dangerous to pour the hot oil from the cooking vessel.
- A fire extinguisher and heavy potholders should always be within reach.

Checking the Temperature of the Oil: A temperature between 350°F and 375°F is an ideal range for deep-frying. The correct temperature can be determined with the use of a candy thermometer. Another

method that can be used is to place a cube of bread into the oil and if it browns in 45 to 50 seconds, the oil is at the correct temperature. The oil should not need to reach over 375°F to fry the fish. Oil above this temperature will brown the fish too quickly, not allowing it to cook properly all the way through. The undercooked fish poses a safety concerns.

Any cooking oil can be used for deep-frying provided it does not smoke or burn at temperatures that may reach as high as 375°F. For a healthier choice, oil low in saturated fat is best to use because the food will absorb a small quantity of oil during the cooking process.

Proper Storage

Refrigerating | Freezing | Super-Chilling | Freezing Tips

Properly preparing fresh fish for storage will allow it to be stored for a longer period of time and maintain its quality. Fresh caught fish should be gutted and cleaned as soon as possible and then stored at the proper temperature until ready to cook. For the best flavor and quality, fish should be prepared for eating within 24 hours of catching but if stored properly it is safe to keep refrigerated for 2 to 3 days.

Fresh caught or market fresh fish should be stored at a temperature 40°F or below and cooked fish should be kept at a temperature 140°F or higher to keep it outside of the temperature zone in which bacteria, that causes food borne illness, grows quickly. The danger temperature zone is a range between 40°F and 140°F. Raw fish can be stored in a refrigerator for 2 to 3 days. Leftover cooked fish can be stored for up to 3 or 4 days. If raw or cooked fish is not going to be used within the recommended time, it should be frozen to prevent it from perishing.

Refrigerating

Raw fish can be stored safely in a refrigerator at 40°F or lower for 2 to 3 days. Oily fish will store longer than lean fish and whole fish will store better than steaks and fillets. There are several factors listed below that will have an affect on how well the fish will store.

- The amount of time that market fresh fish can be refrigerated will depend on:
    - If it was stored properly after it was caught, before it got to the market.
    - How fresh the fish was when purchased.
    - Whether or not the fish was stored properly on ice at the market.
    - The temperatures it is exposed to in transporting from the store to home refrigeration.
    - The type of packaging used.

- The amount of time that fresh caught fish can be refrigerated will depend on:
    - How the fish was handled after being caught.
    - How long it was kept alive.
    - Whether or not it was bruised from flopping around on the bottom of the boat or on the dock.
    - If there was any damage done to its skin.
    - How soon it was cleaned and if it was cleaned properly.

Follow the instructions below to store fresh fish in the refrigerator properly.

1. Remove the fish from the wrapper. Thoroughly rinse the fish in cold water.
2. Pat it dry with a paper towel.
3. Line a plate or pan with a double layer of paper towels and place the fish on the towels.

4. Cover them tightly with plastic wrap or aluminum foil and place in the coldest part of the refrigerator, the top shelf in the back.
5. Be sure the fish is tightly wrapped so that if there are any juices from the raw fish, they will not come in contact with any other food.

Cooked Fish Leftovers: Cooked leftovers should be cooled and refrigerated as soon as possible, limiting the amount of time the fish is exposed to room temperatures. Never leave the fish at room temperature for more than two hours. Store it in a shallow covered container to allow the fish to cool to the proper temperature more quickly. Cooked fish can be stored for up to 2 to 3 days in a refrigerator at 40°F or less. If leftovers are not going to be used within this time, they can be frozen and stored for up to one month.

Freezing

Fresh fish can be stored at 40°F or less for 2 to 3 days but if it is not going to be used within that time, it should be frozen to prevent it from perishing. Freeze the fish while it is as fresh as possible. Proper handling of the fish is also necessary to produce a quality frozen product. The same factors stated above will have an affect on the quality of the fish when it is frozen. Be sure the fish has been cleaned properly before freezing. There are several methods that can be used for freezing fish. The method you select may depend on if you are freezing whole fish, large cuts, steaks or fillets. Also, take into consideration how much freezer storage room you have available. Fish should be frozen in a freezer at 0°F or less. Several methods are shown below.

Double Wrapping: This method works well on smaller whole fish, steaks and fillets. It saves freezer storage space and the individual pieces thaw easier when you are ready to use them.

1. Wrap the fish individually in plastic wrap. Wrap as tightly as possible.
2. Wrap tightly again with another layer of wrap.
3. Place the individually wrapped pieces into a sealable freezer bag or wrap tightly in aluminum foil. If using a bag, be sure to press out excess air from the bag.
4. Do not package more that one pound in each bag. This will allow the fish to freeze more quickly.
5. When placing in the freezer, do not stack a lot of packages together in one area. Try to spread them out in the freezer so they will freeze quicker. Once they are frozen, they can be stacked neatly on top of each other.

Freezing in a Block of Ice: This method works well for smaller pieces, such as steaks and fillets. Freezing in a block of ice protects the fish from being exposed to any air because the air cannot penetrate through the ice. This guards the fish against freezer burn. This method requires more room in the freezer for storage and is a little more work when it comes to thawing the fish.

1. Select a container for freezing the fish in ice, such as paper milk cartons, small baking pans, loaf pans, or plastic storage containers. Select a container that would hold only enough for one meal. Do not use too large of a container because it will take too long to freeze and it will be harder to find room in the freezer.
2. Cut fish into serving size pieces.
3. Place the fish in the container, leaving an inch or more of headspace for expansion during the freezing process.
4. Cover the fish with cold water.
5. Place in the freezer so that the container sits level. Allow the water to freeze in a solid block.

6. If the fish have floated to the top so they are not completely covered with ice, remove the container and add a layer of water to the top so the fish is completely covered and return to the freezer until the additional water is frozen.
7. If the fish was frozen in a pan, run a little cold water on the bottom of the pan and pop the block of ice out.
8. Wrap the block of ice with a double layer of plastic wrap or aluminum foil.
9. Place the wrapped block in a sealable freezer bag. Remove excess air and seal. The wrapped block could also be wrapped in freezer paper rather than placed in a freezer bag.
10. If a milk carton was used, cover tightly with aluminum foil. If a plastic container was use, place the cover on and seal tightly.
11. Place the fish back into the freezer as soon as possible.

Glazing: This method works well for whole fish or large cuts. Glazing seals the fish with a thick layer of ice to protect it from exposure to air. Once the fish have been glazed they will require less freezer space.

1. Lay the fish out on a baking sheet in a single layer without wrapping.
2. Place in the freezer until frozen.
3. Remove the fish from the freezer and dip each individual fish into a bowl of ice water.
4. Place back on the baking sheet and freeze again.
5. Repeat this process until the fish has an ice coating built up to at least 1/8 inch thick.
6. Place the glazed fish into an airtight freezer bag or container.
7. Place back in the freezer as soon as possible.
8. Periodically check the glazing on the fish. A layer of glaze may have to be repeated if stored for an extended period of time.

When using any of the freezing methods, be sure to mark the packages with contents and the date so you can be certain of how long it has been stored in the freezer and what it contains.

Be sure all wrapped packages are sealed tightly and any fish frozen in ice is completely covered with ice to prevent ice crystals from forming on the fish. Ice crystals form because moisture has been drawn out of the fish, causing it to become freezer burned. Freezer burned areas of the fish become distasteful and tough or dried out. Store bought frozen fish should be left in the original package and place in the freezer as soon as possible. For extra protection place the store bought package in a freezer bag before placing in the freezer.

Freezing Cooked Fish Leftovers: If you have cooked fish leftovers that are not going to be eaten within 2 or 3 days, you can freeze them for extended storage. Place the cooked fish in shallow covered container to allow the fish to freeze more quickly. Cooked fish can be stored in the freezer for up to one month.

It is always best to freeze and store frozen food in a freezer unit, rather than a refrigerator freezer. The freezer units will maintain a temperature of 0°F or below, which will allow food to be stored for longer periods of time. A refrigerator freezer will generally only maintain a temperature of 10°F to 25°F and is opened more often, which causes fluctuation in temperature. If fish is stored in a refrigerator freezer, it should be used within one to two months. The chart below shows storage times for fish when stored in a refrigerator or freezer.

Storage Times
(Suggested times for maximum quality)

	Refrigerator (40°F)	Freezer (0°F)
Fresh Oily Fish - Whole Fish	Two to three days	1 1/2 to 2 months
Fresh Oily Fish - Steaks & Fillets	Two to three days	1 to 1 1/2 months
Fresh Lean Fish - Whole Fish	Two to three days	4 to 6 months
Fresh Lean Fish - Steaks & Fillets	Two to three days	3 to 4 months
Store Packaged Frozen Fish	Use within 24 hours of thawing	3 to 6 months
Cooked Fish	Two to three days	One month
Note: If storing longer than the storage times shown above, the quality may be affected.		

Super-Chilling Fish

Super-Chilling fish is a good method of storing fish that needs to be transported a distance when freezing capabilities are not available. If stored properly, fish can be kept fresh for up to 6 or 7 days. See instructions below for super-chilling.

1. Clean fish properly and leave whole.
2. Wrap the fish tightly with two layers of plastic wrap or with aluminum foil.
3. Mix 1 pound of rock salt with 20 pounds of crushed ice. If storing a small quantity of fish the amount of salt and ice can be reduced proportionately.
4. Add a 4 inch layer of plain crushed ice on the bottom of the cooler.
5. Place a layer of the wrapped fish on top of the ice layer.
6. Add another layer of the ice mixture on top of the fish.
7. Repeat these layers until all the fish are covered.
8. Be sure to have a thick layer of the ice mixture on top when finished.
9. Place the cover tightly on the cooler.
10. Occasionally check the level of ice mixture. More may need to be added as the ice melts.
11. If transporting the cool in a manner that the water can drain from the cooler, leave the drain open. If not, you may have to stop occasionally to remove the cooler and allow the water to drain. Replenish ice mixture if necessary.
12. This method will keep the fish chilled at a cooler temperature than if refrigerated.

Storage Tips:

- Be sure fish is cleaned properly before storing.
- When storing in a refrigerator, be sure the temperature is 40°F or less.

- Do not allow cooked fish to sit at room temperature for more than 2 hours.
- DO NOT REFREEZE FISH THAT HAS BEEN THAWED.
- Be sure all packages are marked with the content and the date it was frozen.
- Wrapping individual pieces of fish in plastic wrap or foil and then placing in a freezer bag will allow you to take out only the number servings you need to prepare.
- Freeze fresh fish as soon as possible to maintain the best quality.
- Store frozen fish in a freezer unit to obtain maximum storage time.
- Thaw frozen fish in the refrigerator or in cold water, changing every 30 minutes. NEVER thaw fish at room temperature.

Fish Consumption Safety

Today there is considerable concern regarding the PCB and mercury levels of the water in which the fish live, thus raising the PCB and mercury levels found in the meat of the fish. Consequently, fish are beginning to be listed into groups of species that should be consumed and species that should be avoided. It is generally agreed that most farm-raised varieties of fish are safe to eat (farm raised salmon are an exception because they typically require significant amounts of mackerel, herring, and other fish as feed, however, if the source is dependable and uses environmentally sound practices, then farm raised salmon can be considered safe to consume).

The charts below list the fish varieties harvested in their natural habitat that are considered safe and those that are questionable or known to be unsafe.

Fish Varieties Considered Safe		
Catfish	Ocean Perch	Shrimp
Crab	Oysters	Striped Bass
Flounder/Sole	Rainbow Trout	Tilapia
Haddock	Salmon - from Alaska	Trout - Farmed
Halibut from the Pacific	Sardines	Tuna - Big-Eye
Herring	Scallops	Tuna - Yellowfin
Lobster		

Fish Varieties Considered Questionable		
Cod - Pacific	Orange Roughy	Shark
Flounder - Atlantic	Salmon - Atlantic	Snapper
Grouper	Salmon - Farmed	Sturgeon
Monkfish	Sea Bass - Chilean	Tuna - Bluefin
Fish Varieties Known to be Unsafe		
King Mackerel	Swordfish	Tuna - Fresh Sardines
Shark	Tilefish	

Mercury affects the development of cognitive, motor, and sensory functions in the brain. It is especially harmful to unborn children and young children. The more mercury a person takes in its body and the longer the exposure time to the mercury, the more serious the affects can be. This is why unborn children and young children run more of a risk. The FDA advises that young children, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not consume fish that are known to have high levels of mercury. The FDA suggest that the pregnant women and nursing mothers also limit the amount of low mercury level fish to 12 ounces per week. The EPA suggests even a more strict limit on low mercury level fish, which is 8 ounces of uncooked (6 ounces cooked) fish one time per week and only 3 ounces of uncooked (2 ounces cooked) fish one time per week for young children. Men and women outside of this group should also limit the amount of fish with high levels of mercury to occasional consumption. Variables such as, the ability of a persons body to tolerate mercury, the level of mercury in the fish, how much fish is consumed, and the body weight of the person consuming the fish will all have an affect on the risks of the mercury consumption.

CHECK YOUR PROGRESS

Why are the Canadian weary of buying Fish?
Why is there no fool-proof way to cook fish?
What are the steps in purchasing fish?

3.05 FISH AND SHELLFISH

Shellfish

Shellfish is a culinary and fisheries term for exoskeleton-bearing aquatic invertebrates used as food, including various species of molluscs, crustaceans, and echinoderms. Although most kinds of shellfish are harvested from saltwater environments, some kinds are found in freshwater. In addition, a few species of land crabs are eaten, for example Cardisoma guanhumi in the Caribbean.

Despite the name, shellfish are not a kind of fish, but are simply water-dwelling animals. Many varieties of shellfish (crustaceans in particular) are actually closely related to insects and arachnids, making up one of the main classes of the phylum Arthropoda. Cephalopods (squids, octopuses, cuttlefish) and bivalves (clams, oysters) are molluscs, as are snails and slugs.

Fig 3.03: Raw oysters, opened, and presented on a plate

Familiar marine molluscs used as a food source by humans include many species of clams, mussels, oysters, winkles, and scallops. Some crustaceans commonly eaten are shrimp, lobsters, crayfish, and crabs. Echinoderms are not as frequently harvested for food as molluscs and crustaceans; however, sea urchin roe is quite popular in many parts of the world.

Fig 3.04: A shrimp cocktail

Most shellfish eat a diet composed primarily of phytoplankton and zooplankton.Shellfish are among the most common food allergens. (“Allegen” is the substance which causes allergy)

The term shellfish is used both broadly and specifically. In common parlance, as in having "shellfish" for dinner, it can refer to anything from clams and oysters to lobster and shrimp. For regulatory purposes it is often narrowly defined as filter-feeding molluscs such as clams, mussels, and oyster to the exclusion of crustaceans and all else.

Although the term is primarily applied to marine species, edible freshwater invertebrates such as crayfish and river mussels are also sometimes grouped under the umbrella term "shellfish".

Fig 3.05: Cooked mussels

Although their shells may differ, all shellfish are invertebrates. As non-mammalian animals that spend their entire lives in water they are "fish" in an informal sense; however the term finfish is sometimes used to distinguish fish as animals defined by having vertebrae from shellfish in modern terminology.

The word "shellfish" is both singular and plural; the rarely used "shellfishes" is sometimes employed to distinguish among various types of shellfish.

Shellfish in various cuisines

Archaeological finds have shown that humans have been making use of shellfish as a food item for hundreds of thousands of years. In the present, shellfish dishes are a feature of almost all the cuisines of

the world, providing an important source of protein in many cuisines around the world, especially in the countries with coastal areas.

Fig 3.06: Sakura ebi

In Japan

In the Japanese cuisine, chefs often use shellfish and their roe in different dishes. Sushi (vinegared rice, topped with other ingredients, including shellfish, fish, meat and vegetables) features both raw and cooked shellfish. Sashimi primarily consists of very fresh raw seafood, sliced into thin pieces. Both sushi and sashimi are served with soy sauce and wasabi paste (a Japanese horseradish root, a spice with extremely strong, hot flavor), thinly sliced pickled ginger root, and a simple garnish such as shiso (a kitchen herb, member of the mint family) or finely shredded daikon radish, or both.

In the United States

Fig 3.07: Boiled Maine lobster

Lobster in particular is a great delicacy in the United States, where families in the Northeast region make them into the centerpiece of a clam bake, usually for special occasions. Lobsters are eaten on much of the East Coast; the American lobster ranges from Newfoundland down to about the Carolinas, but is most often associated with Maine. A typical meal involves boiling the lobster with some slight seasoning and then serving it with drawn butter, baked potato, and corn on the cob.

Clamming is done both commercially and recreationally along the Northeast coastline of the US. Various type of clams are incorporated into the cuisine of New England. The soft-shelled clam is eaten either fried or steamed (and then called "steamers"). Many types of clams can be used for clam chowder, but the quahog, a hard shelled clam also known as a chowder clam, is often used because the long cooking time softens its tougher meat.

The Chesapeake Bay and Maryland region has generally been associated more with crabs, but in recent years the area has been trying to reduce its catch of blue crabs, as wild populations have been depleted. This has not, however, stemmed the demand: Maryland-style crabcakes are still a well known treat in crabhouses all over the bay, though the catch now comes from points farther south.

Fig 3.08: Scallop sandwich served in San Diego

In the Southeast, and particularly the gulf states, shrimping is an important industry. Copious amounts of shrimp are harvested each year in the Gulf of Mexico and the Atlantic Ocean to satisfy a national demand for shrimp. Locally, prawns and shrimp are often deep fried; in the Cajun and Creole kitchens of Louisiana, shrimp and prawns are a common addition to traditional recipes like jambalaya and certain stews. Crawfish are a well known and much eaten delicacy here, often boiled in huge pots and heavily spiced.

In many major cities with active fishing ports, raw oyster bars are also a feature of shellfish consumption. When served freshly shucked (opened) and iced, one may find a liquid inside the shell, called the liquor. Some believe that oysters have the properties of an aphrodisiac.

Inter-tidal herbivorous shellfish such as mussels and clams can help people reach a healthy balance of omega-3 and omega-6 fats in their diets, instead of the current Western diets. For this reason, the eating of shellfish is often encouraged by dietitians. Shellfish, however, are a rich source of the amino acid taurine.

Around the world

Fig 3.09: Large shrimp or prawns for sale in Italy

Fig 3.10: A dish of cooked freshwater nerites from the Rajang River, Sarawak, Malaysia

Shellfish is a common part of indigenous cuisines throughout the globe. Some popular dishes using shellfish:

- Ceviche
- Cioppino
- Callaloo
- Clam chowder
- Curanto
- Fruits de mer
- Paella
- Sashimi
- Shrimp cocktail
- Lobster bisque
- She-crab soup
- Sliced fish soup
- Sushi
- Shrimp Saganaki

Allergy

While estimates vary from shellfish, approximately 1% of the population is estimated to suffer from seafood allergy, which is more common in teenage and adult life than very early childhood. An estimated 20% will grow out of their allergy with time.

Toxic content

Some shellfish, such as whelk, contain arsenic. A sample of whelk was found to have a total content of arsenic at 15.42 mg/kg of which 1% is inorganic arsenic.

Nutritional values

Shellfish	Protein(g)	Fat(g)	Sodium(mg)[citation needed]
Oysters (raw)	10.8	1.3	5.0
Mussels (boiled)	16.7	2.7	360
Clams (canned)	16.0	0.6	1200
Shrimp (boiled)	23.8	2.4	3840
Prawns (boiled)	22.6	0.9	1590
Lobsters (boiled)	22.1	1.6	330
Crayfish (raw)	14.9	0.8	150
Crabs (boiled)	19.5	5.5	420
Cuttlefish (raw)	16.1	0.7	370
Octopus (raw)	17.9	1.3	120
Squid (raw)	15.4	1.7	110

(Source: Wikipedia)

CHECK YOUR PROGRESS

Which are popular shellfish dishes from Japan?
Which shell fish is most rich in protein content?

3.06 CLASSIFICATION OF FISH AND SHELLFISH

(Source: Dana Point Fish Company.com)

Fig 3.11: Various Seafood

Finfish – Freshwater

Freshwater Fish (fish that live in fresh waters)

Examples: catfish, lake trout, bluegill, perch, carp, pike, crappie, etc.

Fig 3.12: crappie

Saltwater Fish (fish that live in salt waters)

Round Fish

Examples: mackerel, salmon, snapper, weakfish, whiting, haddock, tuna, mahi mahi, whitefish.

Fig 3.13: whitefish

Flat Fish (has eyes on one side of head, oval body shape)

Examples: sole, flounder, diamond turbot, halibut, sanddabs.

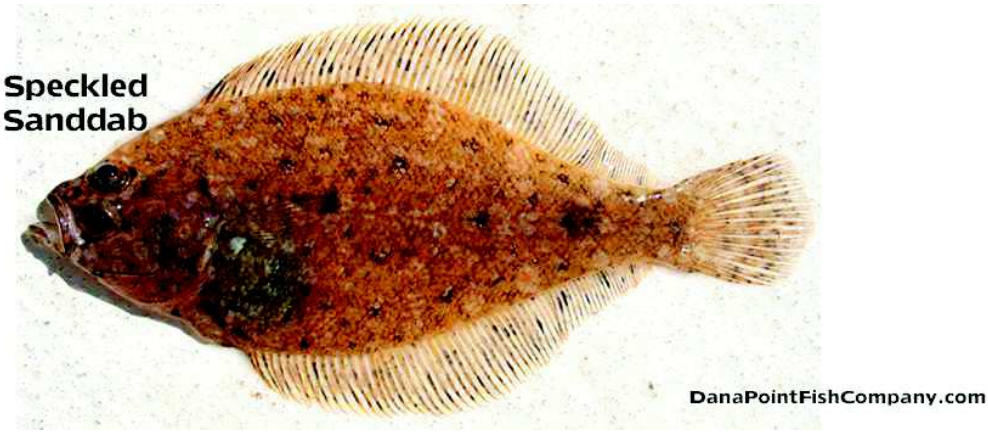


Fig 3.14: speckled-sanddab

Cartilaginous Fish

(has no bones, cartilage skeleton)

Example: shark, gray smoothhound.

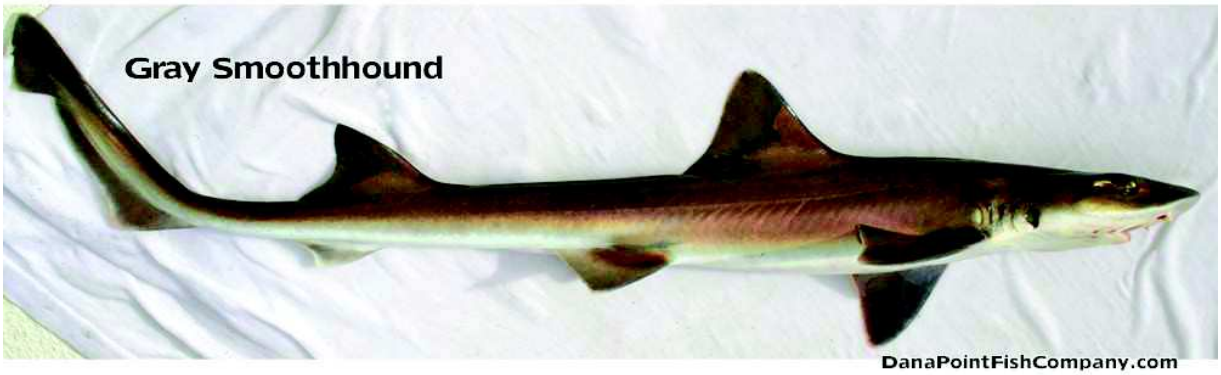


Fig 3.15: gray-smoothhound

Shellfish and Mollusks

Univalve

(one shell)

Examples: conch, abalone, whelks.

Fig 3.16: abalone

Bivalve

(two shells)

Examples: clams, oysters, mussels.

Fig 3.17: mussels

Gastropods

(mollusk having a one-piece shell or no shells, usually move with one muscular ventral foot)

Examples: snails, limpets, slugs.

Fig 3.18: whelk

Crustaceans

(having a shell with jointed appendages)

Examples: crayfish, crawfish, shrimp, lobster, prawns, snow crab, Dungeness crab, blue crab.

Fig 3.19:snow-crab

Cephalopods

(marina animal with a head and eyes, arms with suckers attached to head, fin bearing mantle)

Examples: squid, octopus, cuttlefish, Humboldt squid.

Fig 3.20: giant-squid

CHECK YOUR PROGRESS

Which are the examples of bivalve ?
What are the cephalopods?

3.07 CUTS OF FISH

Like many other animals we eat, fish also have different cuts. Most people will have heard of fillets or steaks however, perhaps due to the ease of transporting all manner of fish around the world, these names have become muddled to the point that some names are no longer used by many fish sellers, which can cause much confusion and disappointment to the shopper.

A good example of this is the current use of the word fillet which now seems to encompass two distinct cuts.

Fig 3.21: normal salmon fillet, often sold in portions which are large enough to serve 1-2, depending on the type of fish, which have been taken from fish which aren't too large.

Fig 3.22: salmon fillet steak more properly called a Suprême, which is usually cut into single-serving pieces taken from a larger fish which would have a thicker than a normal fillet.

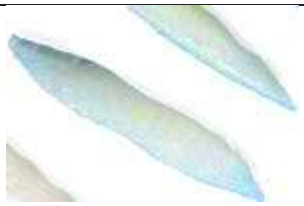
With online shopping becoming more and more popular, it is now even more important for the right name to be given to the right cut as, even with major online outlets, the picture shown may not necessarily match the product delivered.

As an example, if you saw the first picture on the left you might think to order 2 x 200g/7oz Fillets to serve four people, which you want spread with an appropriate stuffing and roll up before baking, which would make an attractive presentation for a dinner party. Instead you get delivered 2 x 200g/7oz Suprêmes (fillet steaks) as shown second picture, because the outlet doesn't differentiate between the two. You can't stuff and roll them and you'll have to halve them which might affect the presentation.

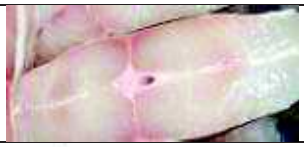
At a much more basic level, the cooking instructions given for a "fillet" will not necessarily apply to a Suprême (fillet steak) as although the overall weight may be the same, the extra thickness of the Suprême will require extra cooking time.

Let us see some basic cuts of fish:

Cut Name	Picture	Description	Suitable Fish
Butterfly Fillets		Round fish are de-headed then filleted by cutting through the belly, gutting the fish, opening it flat then removing the backbone and smaller bones, leaving the two fillets on each side of the fish joined in a 'butterfly' style . The central bone can also be removed by cutting along the back after which the guts can be taken removed without splitting the belly	Any small to medium sized whole round fish, usually single portion specimens such as bass, herring, mackerel, mullet, sardines, tilapia, trout, whiting.

Cheeks		As the name implies, these are cut from the head of larger mature fish and are the small pockets of flesh found just below each eye. Hailed by many as one of the tastiest parts of a fish, they are round-ish	Usually taken from larger specimens such as monkfish, cod, hake, haddock, halibut
Cutlets		A single-serving cross-section portion sliced straight through the backbone of a whole, dressed, round fish. In general, they are slightly thinner than a *steak,* usually around 12mm/½-inch thick, and most often cut from the section between the head and mid-body.	Any medium sized round fish. See also **darnes and steaks**
Darnes		Single-serving portions taken from a cross section straight through the backbone of a whole, dressed, round fish, In general, they are slightly thinner than a *steak,* usually around 12mm/½-inch thick, and most often cut from the section between the head and mid-body. Also known as cutlets.	Any medium sized round fish See also **cutlets, steaks** and **tronçons -** the flat fish version
Fillets		Available from any fish - round or flat. Fillets can be the boneless or 'pin bone-in' and consist of the complete sides of a fish from just below the gills to tail, being cut away from the backbone and removed in one piece. Fillets from larger fish can be further cut down into single-serving size portions such as **Suprêmes, Pavés** or **Goujons**.	Most, whether round or flat, large or small. Exceptions include ray, skate and monkfish
Goujons		Narrow strips up to 10cm/4-inches long x 1cm/½-inch wide x 1cm/½-inch thick which are cut from a fillet. Goujons are best known for being coated with breadcrumbs before being deep fried.	Any so long as the fillet is thick enough.

Loins		The prime part of a fillet taken from larger round fish such as Cod or from either side of the backbone of large game fish like Tuna. Smaller loins from fish such as Hake may be single-portion size.	Large round fish such as cod, haddock, hake or monkfish and large game fish such as swordfish or tuna
Pan-Dressed		Small to medium sized whole fish which have been scaled, gutted and had the fins, head and tail removed so as to fit into a frying pan. Usually single-serving whole fish.	All small to medium sized round or flat fish See also **Dressed fish and Whole fish**
Pavés		Boneless portions taken from the fillets of larger flat fish which can serve 1 - 2 people depending on how large the fish is. The fillets are cut in half or into thick portions widthways and normally the skin is left on. Sometimes referred to as **Suprêmes** or just **fillets,** both of which are incorrect and and can lead to confusion.	Larger flat fish such as Halibut, Turbot and Brill
Steaks	 	1. A thick, usually boneless piece of fish cut from larger fish such as tuna or swordfish 2. Portions cut through the bone of a whole dressed round or flat fish similar to a cutlet but slightly thicker and often cut from between the mid-body and tail.	Larger round fish such as Salmon, Haddock, Cod, Hake and Tuna or larger flat fish such as Halibut, Brill and Turbot See also **cutlets, darnes and tronçons**
Suprêmes		Also sometimes called fillet steaks, these are boneless single-serving portions cut from larger fillets of both round and flat fish. The fillets are cut widthways into slices around 5cm/2-inches wide. Sometimes referred to as **pavés**, but often just called **fillets** both of which names are incorrect and can lead to much confusion.	Larger round and flat fish fillets such as Salmon, Cod, Halibut, Turbot and Snapper

Tail		These are generally larger all-in-one pieces, consisting of the part of the fish nearest to the tail fin in a solid piece which always include the bone. They can be likened to meat "joints" in that they can be large enough to serve several people and are excellent roasted in one piece.	Any large round fish such Salmon, Hake, Cod, Monkfish, Sea Bass
Tronçons		Portions which are cut through the bone of a whole flat fish usually into single portion sizes. Also called steaks.	Any large flat fish such as Halibut, Brill and Turbot
Whole		Whole fish of any size as caught which haven't had anything done to them whatsoever.	All, See also **Dressed and Pan-dressed fish**
Wings		Before being sold the wings are usually removed and sometimes skinned. Wings from larger specimens have to be further cut down into portions as these fish can reach very large sizes.	Skate and Rays

CHECK YOUR PROGRESS

How do you get butterfly fillet cut?
Which fish is most suited for Wing cut?
What is Supreme cut?

3.08 POPULAR SPECIES OF FISH

Over 32,000 species of fish have been described, making them the most diverse group of vertebrates. In addition, there are many species of shellfish. However, only a small number of species are commonly eaten by humans.

Common species of fish and shellfish used for food			
	Mild flavour	**Moderate flavour**	**Full flavour**
Delicate texture	Basa, flounder, hake, scup, smelt, rainbow trout, hardshell clam, blue crab, peekytoe crab, spanner crab, cuttlefish, eastern	Anchovy, herring, lingcod, moi, orange roughy, Atlantic ocean perch, Lake Victoria perch, yellow perch, European	Atlantic mackerel

	oyster, Pacific oyster	oyster, sea urchin	
Medium texture	Black sea bass, European sea bass, hybrid striped bass, bream, cod, drum, haddock, hoki, Alaska pollock, rockfish, pink salmon, snapper, tilapia, turbot, walleye, lake whitefish, wolffish, hardshell clam, surf clam, cockle, Jonah crab, snow crab, crayfish, bay scallop, Chinese white shrimp	Sablefish, Atlantic salmon, coho salmon, skate, dungeness crab, king crab, blue mussel, greenshell mussel, pink shrimp	Escolar, chinook salmon, chum salmon, American shad
Firm texture	Arctic char, carp, catfish, dory, grouper, halibut, monkfish, pompano, Dover sole, sturgeon, tilefish, wahoo, yellowtail, abalone, conch, stone crab, American lobster, spiny lobster, octopus, black tiger shrimp, freshwater shrimp, gulf shrimp, Pacific white shrimp, squid	Barramundi, cusk, dogfish, kingklip, mahimahi, opah, mako shark, swordfish, albacore tuna, yellowfin tuna, geoduck clam, squat lobster, sea scallop, rock shrimp	Barracuda, Chilean sea bass, cobia, croaker, eel, blue marlin, mullet, sockeye salmon, bluefin tuna

CHECK YOUR PROGRESS

What are the examples of fish which have delicate texture and moderate flavor?
What are the examples of fish which have firm texture and mild flavor?
What are the examples of fish which have medium texture and moderate flavor?

3.09 CLASSICAL PREPARATION OF FISH

In this section we will learn a few Indian Fish dishes.

Batter Fried Fish Recipe

Ingredients:

- 900 gms./ 2lb Fish
- 1cup gram flour (besan)
- 1 green chili (chopped)
- Salt To Taste
- 1/2 tsp turmeric powder
- 3 tbsp fresh bread crumbs
- 1/2 tsp red chili powder
- 1/2 black pepper powder
- 2 cups water

- 3 tbsp chopped coriander leaves
- For Garnishing :
- 1 lemon (sliced)
- 2 tomatoes (sliced)

Method:

- Wash the fish thoroughly and cut into pieces. Rub the turmeric over the fish pieces with about 1tsp salt and set aside for 15-20 minutes.
- Rinse the fish under running water.
- Mix gram flour, bread crumbs, salt, chili & pepper powder, green chili, coriander and water and form a smooth batter.
- Heat the oil in a kadhai or wok .
- Coat the fish nicely with batter and deep-fry until golden all over on a moderate heat for about 8-10 minutes.
- Serve batter fried fish hot garnished with lemon & tomato slices.

Fish Korma Recipe

Ingredients:

- 1 kg fish
- 1/2 cup curd
- 1/2 cup onion paste
- 2 tsp ginger paste
- 1 tsp garlic paste
- 1 tbsp coriander paste
- 6 cardamom
- 1 inch cinnamon
- 2 tsp salt
- 3/4 cup ghee or oil
- 6 green chilli
- 2 tbsp kewra
- 1 tbsp sugar
- 1 tbsp lemon juice

Method:

- Use large fish for korma.
- Do not cut the fish into too small pieces.
- Carp is great for Korma.
- Except for the green chilles and kewra, add all the rest of stuff into the cooking dish. Mix well. Heat covered in low heat.
- Turn over the fish once (be careful).
- When the water has almost dried up, add the green chilli and the kewra heat for another half hour in very low heat.

- When the oil begins to float on top, you are done.
- Serve fish korma hot with tandoori roti or rice.

Maccher Jhol (Fish In Bengali Sauce)

Ingredients:

- 800 gms white-fleshed fish
- 1/2 tsp ground turmeric
- 1/2 tsp salt
- 2/3 mustard oil or vegetable oil
- 1 tbsp ground coriander seeds
- 1 tsp ground cumin seeds
- 1 1/2 tsp finely grated ginger
- 1 tsp ground turmeric
- 1/2 tsp red chilli powder
- 1/2 tsp salt
- 1/4 tsp kalonji
- 4 whole red chillies dried
- 2 bay leaves
- 1 large onion peeled, chopped
- 3 whole green chillies

Method:

- Cut the fillets in about 4cm size.
- Rub the fish well with the 1/2 tsp of turmeric and 1/2 tsp of salt and set aside for 10-15 minutes.
- Heat the oil in a non-stick frying pan over a medium flame. If you are using mustard oil, let it get smokingly hot.
- Now put in the fish pieces and brown lightly on all sides without cooking them through.
- Gently lift the fish out of the oil and put it on a plate. Turn off the heat.
- Combine the ground coriander seeds, the cumin, ginger, 1 tsp turmeric,chilli powder (cayenne pepper) and 1/2 tsp of salt in a small bowl. Add 3 tbsp of water and mix.
- Remove all but 5/6 tbsp of oil from the frying pan. Heat the frying pan over a medium flame.
- When hot, put in the nigelia seeds. A few seconds later, put in the red chillies.
- As soon as they darken a bit, put in the bay leaves. When the bay leaves start to darken, put in the onion.
- Stir and fry the onion, lowering the heat, if necessary, until it is translucent and lightly browned. Add the spice paste. Stir and fry it for about 1 minute.
- Now put in the fish in a single layer as well as 1 cup of water. Lay the green chillies over the fish.

- Simmer over a medium heat for 2 minutes, spooning the sauce over the fish pieces as you do so. Now cover, turn the heat to low and cook the fish for 10-15 minutes or until it is just done.
- Serve machher jhol (fish in bengali sauce)with rice.

CHECK YOUR PROGRESS

How do you prepare Machcher Jhol?
Write the recipe for Fish Korma.
How do you prepare Fish Fried?

3.10 COMMON COOKING METHODS FOR SEAFOOD

There are many different methods of cooking seafood, and all of them have their strengths – some are quick, some are healthy, and some are just plain easy.

Below, we've summarised the four most popular methods of cooking fish - of course, if you're ever really in a hurry, many species of seafood can be cooked in the microwave, and fish and shellfish both make great additions to any barbecue.

- Grilling
- Baking
- Poaching
- Shallow frying

Grilling

Grilling seals in the moisture, nutrients, and flavour of the fish - so it's no surprise that it's one of the most popular methods of cooking fish. Our top tips for grilling:

- Be sure to baste the seafood during grilling, to prevent it from drying out.
- Place fish skin-side up.
- Score whole fish at the thickest part to enable the heat to penetrate.
- Cooking time, on a medium heat, is usually between 8 and 10 minutes.

Grilling is fantastic with halibut steaks and fillets of fish with the skin still on. Small whole fish such as small mackerel, herring and sardines are also great for grilling.

Baking

Baking fish is perfect if you're looking for a way to cook your seafood along with other vegetables, herbs or spices. Our top tips for baking:

- Fish can be baked either in an oven-proof dish or kitchen foil.
- Fish doesn't benefit from high oven temperatures. Small whole fish, fillets, steaks and cutlets can be cooked for around 15-20 minutes at 200ºC/400ºF/gas mark 6. Large whole fish should be baked at 180ºC/350ºF/gas mark 4 for about 30-40 minutes.
- Delicate whitefish should be coated with oil or butter before baking.

Baking is great with all kinds of fish, except shellfish. If you'd like to bake shellfish, it must be wrapped in kitchen foil first.

Poaching

Poaching is fantastic if you're looking for a way to cook your fish while keeping it moist and tender. Our top tips for poaching:

- Poach your fish in water, milk, stock, wine, or cider.
- Use the leftover poaching liquid to make a sauce for your fish.
- Cook the seafood just below boiling point.
- Poaching takes from 5 minutes, for cubes of fish, to 10-15 minutes.
- Poaching works well with whitefish, such as cod fillets, turbot steaks and halibut. Whole fish including sole, sea bass, and smoked cod and haddock are also great for poaching.

Shallow frying

If you don't want to deep fry, shallow frying is probably the closest you'll get to chip shop fish 'n' chips - it's also a bit healthier. Our top tips for shallow frying:

- Coat the fish thoroughly in batter or breadcrumbs to protect the flesh and stop the fish from absorbing too much fat.
- Use seasonal flour and a small amount of oil for frying - just 2-3 tablespoons.
- Shallow frying should take around 4-5 minutes, and the fish should be turned once.
- Whitefish is fully cooked when its colour is an opaque white.
- Shallow frying works well with all white flatfish, including both halibut and plaice.

CHECK YOUR PROGRESS

How can fish be baked?
What points are to be remembered while shallow frying sea food?
How is the poaching technique used while cooking seafood?

3.11 SUMMARY

In this unit, we have studied Fish and Seafood. Fish are very healthy source of nutrition as they provide the right mix of poly-saturated, unsaturated and mono-saturated fatty acids. Fish provides a good source of high quality protein and contains many vitamins and minerals. They are source of food for people living near river and coastal area. Fish are classified as Freshwater Fish (like catfish, Grayling, Pickerel, Pike, Rainbow Trout, Sunfish, Tilapia, Trout, Walleye Pike, Whitefish, Zander) and migratory fish which mature in saltwater and migrate to freshwater to spawn (like Eel, Salmon, Shad, Smelt, Rockfish, Sturgeon) and Saltwater Fish (like Tuna, Weakfish, etc). We have studied some rules while purchasing fish. We study how to preserve and store fish. Storing considerations include contamination prevention (cleanliness, using different platter and cooking utensils for cooking fish than what was used for raw fish, etc), handling fisherman's catch (keeping fish alive till done fishing, keeping temperature of fish below 40F, etc) Cooking safety, Deep Frying safety, Checking temperature of oil, Storage considerations, Refrigeration, handling cooked fish leftover, Freezing, Double Wrapping, Freezing in a block of ice, glazing, freezing cooked fish leftover, fish consumption safely, etc.

Shellfish is a culinary and fisheries term for exoskeleton-bearing aquatic invertebrates used as food, including various species of molluscs, crustaceans, and echinoderms. Although most kinds of shellfish are harvested from saltwater environments, some kinds are found in freshwater. Shellfish is a common part of indigenous cuisines throughout the globe. Some popular dishes using shellfish: Ceviche, Cioppino, Callaloo, Clam chowder, Curanto, Fruits de mer, Paella, Sashimi, Shrimp cocktail, Lobster bisque, She-crab soup, Sliced fish soup, Sushi, Shrimp Saganaki, etc.

Fish and shellfish can be classified as finfish (freshwater), Saltwater fish, Shellfish and mollusks.

There are about fifteen type of fish cuts which we study: Butterfly fillet, Cheeks, Cutlets, Darnes, Fillets, Gourjons, Loins, Pan-dressed, paves, steaks, Supremes, tails, Tronçons, whole and wing.

We also study popular species of fish according to a matrix of texture (delicate, medium, firm) and flavor (mild, moderate and full).

We study some popular recipe like batter fried fish, fish korma and maccher jhol (fish in Bengali sauce). Fish can be cooked using grilling, baking, poaching and shallow frying. We discuss the specific tips while using these techniques.

As fish is a very important food item and needs very careful handling, it is essential for a hospitality professional to understand these issues thoroughly.

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3.11 END QUESTIONS

The following questions should help you prepare for the End Examinations. These questions are for 5 marks each and should take you 11 minutes under examination conditions.

1. Describe the importance of fish in cooking
2. Explain the various types of fishes
3. Describe ways to store fish
4. Explain what is meant by fish and shellfish

5. Describe various cuts of fish
6. Explain popular species of fish
7. Describe the preparation of dishes of fish
    - .

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http://www.indianfoodforever.com/non-veg/fish/fried-fish.html

http://www.indianfoodforever.com/non-veg/fish/tandoori-fish.html

http://www.indianfoodforever.com/non-veg/fish/patrani-macchi.html

UNIT 4 VEGETABLE, CUTS & COOKERY

Program Name: V101:BSc (HTS) 2016 pattern, V102: BSc(HSCS) 2016 Pattern

Course Name: HTS201: Food Production Foundation –II

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Structure:

4.00 BEFORE WE BEGIN

This is the last unit of the course. We will study about the vegetables in this unit.

In everyday usage, a vegetable is any part of a plant that is consumed by humans as food as part of a savory meal. The term vegetable is somewhat arbitrary, and largely defined through culinary and cultural tradition. It normally excludes other food derived from plants such as fruits, nuts, and cereal grains, but includes seeds such as pulses. Vegetables can be eaten either raw or cooked and play an important role in human nutrition, being mostly low in fat and carbohydrates, but high in vitamins, minerals and fiber. Many nutritionists encourage people to consume plenty of fruit and vegetables, five or more portions a day often being recommended.

The color of vegetable changes due to heat. We study why it happens. The green color of the vegetable is due to pigment chlorophyll. several changes happen when a green vegetable goes into boiling water. First, a brighter green color develops, caused by the expansion of gases and their escape from spaces between plant cells. The collapse of these rather cloudy pockets of gas reveals the bright-green chloroplasts within the cells. A second color change occurs in response to acidic water: The magnesium ion in the center of the chlorophyll molecule is replaced with a hydrogen atom, causing the green to dull. Chlorophyll-a becomes gray-green pheophytin-a, and chlorophyll-b turns into yellowish pheophytin-b. If the boiling water is slightly alkaline, then chlorophyll stays greener. Fried vegetables change to a duller green color when temperatures reach 140 degrees Fahrenheit. The heat damages chloroplasts, releasing natural cell acids to turn green into olive-green. We also study color changes of ther colors.

The various ways in which cooking affects vegetables should be thoroughly understood by the housewife and professionals. In the first place, some methods conserve the food material whereas others waste it. If the vegetables are to be boiled and the boled water is to be consumed then the nutrients will get utilized properly. But if you throw the boiled water the food material gets wasted.

Most are low in fat and calories but are bulky and filling. They supply dietary fiber and are important sources of essential vitamins, minerals, and trace elements. Particularly important are the antioxidant vitamins A, C, and E. When vegetables are included in the diet, there is found to be a reduction in the incidence of cancer, stroke, cardiovascular disease, and other chronic ailments.

We study various cuts of vegetable like julienne, jardinière, dice, mince, crush etc.

This unit is very important to you as a professional as the rudimentary knowledge about vegetables makes you understand food preparation in much better way.

4.01 UNIT OBJECTIVES

After studying this unit you will be able to

- Describe the importance of vegetable in the daily diet
- Explain the nature of pigments in vegetable which give rise to various colors
- Describe the effect of the heat on the pigments and color of vegetable
- Explain the effect of heat on vegetable
- Describe nutritional and hygiene aspects of vegetable
- Explain various cuts on vegetable

4.02 INTRODUCTION TO VEGETABLE

In everyday usage, a vegetable is any part of a plant that is consumed by humans as food as part of a savory meal. The term vegetable is somewhat arbitrary, and largely defined through culinary and cultural tradition. It normally excludes other food derived from plants such as fruits, nuts, and cereal grains, but includes seeds such as pulses. The original meaning of the word vegetable, still used in biology, was to describe all types of plant, as in the terms "vegetable kingdom" and "vegetable matter".

Originally, vegetables were collected from the wild by hunter-gatherers and entered cultivation in several parts of the world, probably during the period 10,000 BC to 7,000 BC, when a new agricultural way of life developed. At first, plants which grew locally would have been cultivated, but as time went on, trade brought exotic crops from elsewhere to add to domestic types. Nowadays, most vegetables are grown all over the world as climate permits, and crops may be cultivated in protected environments in less suitable locations. China is the largest producer of vegetables and global trade in agricultural products allows consumers to purchase vegetables grown in faraway countries. The scale of production varies from subsistence farmers supplying the needs of their family for food, to agribusinesses with vast acreages of single-product crops. Depending on the type of vegetable concerned, harvesting the crop is followed by grading, storing, processing, and marketing.

Vegetables can be eaten either raw or cooked and play an important role in human nutrition, being mostly low in fat and carbohydrates, but high in vitamins, minerals and fiber. Many nutritionists encourage people to consume plenty of fruit and vegetables, five or more portions a day often being recommended.

CHECK YOUR PROGRESS

What is vegetable?
What is the importance of the vegetable in diet?
Why do nutritionists encourage people to consume plenty of fruits and vegetables?

4.03 PIGMENT AND COLOR CHANGES

Did you ever notice when vegetables are cooked they brighten up? Spinach becomes a bight green, then if it's cooked too long it seems to turn grey. What is behind this color change? How can we keep the color? Why does the color change occur?

About Vegetables with Color

The rich, enticing colors that add eye appeal to fresh fruits, vegetables, leaves and flowers can change when heated or exposed to acid. Autumn leaves go from green to bright, glowing hues. French hydrangeas (Hydrangea macrophylla), hardy in U.S. Department of Agriculture plant hardiness zones 6 through 9, have pink flowers when planted in alkaline soil and blue flowers when in acidic soil. Four kinds of plant pigments behave differently when exposed to heat or acidity, producing color changes.

Fruits and Vegetables owe their colors to various plant pigments. Spinach is green because it contains the pigment chlorophyll.Chlorophyll is a chlorin pigment, which is structurally similar to the iron-containing porphyrin compound known as heme. At the center of the chlorin ring is a magnesium ion. The side chains vary somewhat between the different forms of chlorophyll found in different organisms. Chlorophyll a is present in all green plants, but chlorophylls b and c also occur in various groups. They also contain carotenoids, determining the color of the plant All green plants contains chlorophyll a, and most vegetables that we eat contain both chlorophyll a and chlorophyll b, some vegetables contain particularly high amounts of total chlorophyll. Best studied of all the vegetables is spinach (Spinacia oleracea in the Latin scientific name), with this vegetable containing about 300-600 milligrams per ounce.

What happens when chlorophyll is heated?

Green

Chlorophyll pigments give plants their green color, and several changes happen when a green vegetable goes into boiling water. First, a brighter green color develops, caused by the expansion of gases and their escape from spaces between plant cells. The collapse of these rather cloudy pockets of gas reveals the bright-green chloroplasts within the cells. A second color change occurs in response to acidic water: The magnesium ion in the center of the chlorophyll molecule is replaced with a hydrogen atom, causing the green to dull. Chlorophyll-a becomes gray-green pheophytin-a, and chlorophyll-b turns into yellowish pheophytin-b. If the boiling water is slightly alkaline, then chlorophyll stays greener. Fried vegetables change to a duller green color when temperatures reach 140 degrees Fahrenheit. The heat damages chloroplasts, releasing natural cell acids to turn green into olive-green.

Chlorophyll has a chemical structure (containing a porphyrin ring) that is quite similar to a chemical structure found within our red blood cells. Chlorophyll however contains a magnesium atom in its center while heme contains an iron atom. When plants are heated and/or exposed to acid (and when green vegetables are cooked and/or exposed to acid), the magnesium gets removed from the center of this ring structure and replaced by an atom of hydrogen. This results in a change from chlorophyll to pheophytin. Chlorophyll a gets turned into a molecule called pheophytin a, and the chlorophyll b gets turned into pheophytin b. The color of the vegetable changes from bright green to olive-gray. (The pheophytin provides a green-gray color, and the pheophytin b provides an olive-green color).

Red and Blue

Reds, blues and purples occur because of a concentration of different kinds of anthocyanins, water-soluble pigments held in plant cell sap. Heating doesn't change them, but they are red in acidic conditions and blue or purple in alkaline conditions. The color of fall leaves happens when the leaf chlorophyll dies. Intense reds and purples of anthocyanins, which are made up of anthocyanidins plus glucose molecules, form best in response to warm, sunny fall days with cool night temperatures that don't fall below freezing. Those conditions lead to abundant sugar formation and better anthocyanin production. Leaves turn red when cell sap is acidic and purplish or blue when cell sap is alkaline. Vegetables and fruits with anthocyanins can change color completely in response to acidity or alkalinity. Under alkaline conditions, sometimes red cabbage leaves turn blue-purple when cooked, blueberry fruits become green in pancakes and garlic cloves turn green or blue when pickled.

Yellow and Orange

Carotenoids are more soluble in fat than in water, and so their colors don't fade much in response to heat. Some change occurs, however, with carrot taproots going from red-orange to more yellow when cooked. When colorful apricot and bright-red tomato fruits are sun-dried, they lose much of their brightness unless they are treated with the antioxidant sulfur dioxide. Carotenoids also have less-intense color under acidic conditions.

White

White or colorless to begin with, anthoxanthins are water-soluble. They become white when in acidic environments and yellow when alkaline conditions prevail. They turn dark in excessive heat. If plant tissues with anthoxanthins are cooked in aluminum, tin or iron containers, their pigments can react with that metal's ions and form colors such as gray, blue, red, green and brown.

CHECK YOUR PROGRESS

What is the source of the green color of vegetable?
What happens to its color when green vegetable is heated?
What are happens to the red color in vegetables when it is heated?

4.04 EFFECT OF HEAT ON VEGETABLE

EFFECT OF COOKING ON VEGETABLES

Fig 4.01: Care must be taken while cooking vegetables

The various ways in which cooking affects vegetables should be thoroughly understood by the housewife and professionals. In the first place, some methods conserve the food material whereas others waste it.

For instance, boiling in water, which is probably one of the most common ways of cooking vegetables, is decidedly advantageous in some respects, but the water dissolves much of the soluble material, such as mineral salts, sugar, etc., found in the vegetables, so that unless some use is made of this water in the cooking of other foods, considerable waste results.

On the other hand, steaming and baking permit no loss of food material, and so they should be applied to vegetables whenever it is desired to conserve food substances.

Tips:

- The flavors of vegetables are greatly changed during the process of cooking, being increased in some cases and decreased in others. In the case of such strongly flavored vegetables as cabbage, cauliflower, onions, etc., it is advisable to dissipate part of the flavor.
- Therefore such vegetables should be cooked in an open vessel in order that the flavor may be decreased by evaporation. Vegetables mild in flavor, however, are improved by being cooked in a closed vessel, for all their flavor should be retained.
- The overcooking of vegetables is sometimes responsible for an increase of a disagreeable flavor. Another feature of vegetables often changed by cooking is their color. For instance, green vegetables do not, upon cooking, always remain green. In many cases, the color may be improved by adding a very small quantity of soda to the water in which the vegetables are cooked.

- Attention should also be given to the length of time vegetables are subjected to heat, for the over boiling of some vegetables is liable to develop an unattractive color in them.
- This is particularly the case with cabbage, cauliflower, and Brussels sprouts, which develop not only a strong, disagreeable flavor but also a reddish color when cooked too long.
- The application of heat to vegetables also has a definite effect on them. By sufficient cooking, the cellulose of vegetables is softened to the extent that it is less irritating and much more likely to be partly digested than that of raw vegetables. The acids of fruits increase upon cooking, and so the acidity of vegetables is increased to a certain extent.
- Vegetables that contain starch are rendered digestible in no other way than by cooking. On the other hand, the protein material of this food is coagulated by the application of heat, just as the white of an egg or the tissue of meat is coagulated and hardened. However, cooking is the only means of softening the cellulose that surrounds this material.
- Still, high-protein foods, such as beans, peas, and lentils, can be much improved if they are cooked in water that is not very hard. The lime in hard water has a tendency to harden them to the extent that they require a much longer time to cook than when soft water is used.
- These vegetables may be still further softened by the addition of a small quantity of soda to the water in which they are cooked, but care should be taken not to use too much soda, as it will injure the flavor.
- When soda is used, the vegetable should be parboiled for 10 or 15 minutes in the soda water and then drained and cooked in fresh water. This method, of course, does not apply to vegetables that are cooked in soda water to retain their color.
- Salt is always added in the cooking of vegetables to season them. In the use of salt, two important points must be borne in mind: first, that it has the effect of hardening the tissues of the vegetable in much the same manner as it hardens the tissues of meat; and, secondly, that it helps to draw out the flavor of the vegetables.
- These two facts determine largely the time for adding the salt. If an old, tough, winter vegetable is to be prepared, it should be cooked until nearly soft in water that contains no salt, and the salt should be added just before the cooking is finished.
- When it is desired to draw out the flavor, as, for instance, when vegetables are cooked for soup or stews, the salt should be supplied when the vegetables are put on to cook.
- Young tender vegetables may be cooked in salt water, but as such water extracts a certain amount of flavor, an effort should be made to use it in the preparation of stews, sauces, and soups.

CHECK YOUR PROGRESS

What could be the disadvantages of boiling vegetable and not using water used in boiling?

What precautions should be taken while cooking vegetables?
What are the advantages of baking vegetables?

4.05 NUTRITIONAL AND HYGEINE ASPECTS

Vegetables play an important role in human nutrition. Most are low in fat and calories but are bulky and filling. They supply dietary fiber and are important sources of essential vitamins, minerals, and trace elements. Particularly important are the antioxidant vitamins A, C, and E. When vegetables are included in the diet, there is found to be a reduction in the incidence of cancer, stroke, cardiovascular disease, and other chronic ailments. Research has shown that, compared with individuals who eat less than three servings of fruits and vegetables each day, those that eat more than five servings have an approximately twenty percent lower risk of developing coronary heart disease or stroke. The nutritional content of vegetables varies considerably; some contain useful amounts of protein though generally they contain little fat, and varying proportions of vitamins such as vitamin A, vitamin K, and vitamin B6; provitamins; dietary minerals; and carbohydrates. Vegetables contain a great variety of other phytochemicals (bioactive non-nutrient plant compounds), some of which have been claimed to have antioxidant, antibacterial, antifungal, antiviral, and anticarcinogenic properties.

Fig 4.02: Vegetables (and some fruit) for sale on a street in Guntur, India

However, vegetables often also contain toxins and antinutrients which interfere with the absorption of nutrients. These include α-solanine, α-chaconine, enzyme inhibitors (of cholinesterase, protease, amylase, etc.), cyanide and cyanide precursors, oxalic acid, and others. These toxins are natural defenses, used to ward off the insects, predators and fungi that might attack the plant. Some beans contain phytohaemagglutinin, and cassava roots contain cyanogenic glycoside as do bamboo shoots. These toxins can be deactivated by adequate cooking. Green potatoes contain glycoalkaloids and should be avoided.

Fig 4.03: Southeast Asian style stir fry ipomoea aquatica in chili and sambal

Fruit and vegetables, particularly leafy vegetables, have been implicated in nearly half the gastrointestinal infections caused by norovirus in the United States. These foods are commonly eaten raw and may become contaminated during their preparation by an infected food handler. Hygiene is important when handling foods to be eaten raw, and such products need to be properly cleaned, handled, and stored to limit contamination.

Dietary recommendations

The USDA Dietary Guidelines for Americans recommends consuming five to nine servings of fruit and vegetables daily. The total amount consumed will vary according to age and gender, and is determined based upon the standard portion sizes typically consumed, as well as general nutritional content. Potatoes are not included in the count as they are mainly providers of starch. For most vegetables and vegetable juices, one serving is half of a cup and can be eaten raw or cooked. For leafy greens, such as lettuce and spinach, a single serving is typically a full cup. A variety of products should be chosen as no single fruit or vegetable provides all the nutrients needed for health.

International dietary guidelines are similar to the ones established by the USDA. Japan, for example, recommends the consumption of five to six servings of vegetables daily. French recommendations provide similar guidelines and set the daily goal at five servings. In India, the daily recommendation for adults is 275 grams (9.7 oz) of vegetables per day.

CHECK YOUR PROGRESS

How many servingsof vegetables are recommended by USDA guidelines?
Describe the various nutrients and other important substances found in most vegetables?
What kind of toxins and antinutrients are found in vegetables?
What precautions shuld be taken while using leafy vegetable so that gastrointestinal infections are not caused by them?

4.06 CUTS OF VEGETABLE

(Source: http://www.wikihow.com/Chop-Food-Like-a-Pro)

One of the first skills that a chef learns is how to chop vegetables and meat quickly. This helps them to complete recipes quickly and time the cooking of the entire meal. If you find yourself unable to chop food quickly, this is a common problem among home cooks. However, with practice you can learn to chop quickly and evenly, which may in turn help the quality of your meals because evenly shaped vegetables incorporate more uniformly as they break down. Knife skills are an essential part of being an efficient and safe cook. They include knowing what knives to use, sharpening knives regularly and holding the food properly. The quality and quickness of chopping will develop in time. Read on to find out how to chop food like a pro.

Choosing a Cutting Surface

Fig 4.04:Choose the correct flat cutting surface.

Do not cut on a worktop surface, especially metal. You need to keep the edge of the knife sharp so use, in order of preference of trained Chefs, High Density Plastic, Low Density Plastic, Wood. Never use glass, only diamond can cut glass so you WILL RUIN ANY KNIFE

Most people suggest a plastic cutting board for cutting vegetables and a wooden cutting board for cutting meat. Wood, kept properly, has natural antiseptic properties. If in doubt clean every board before, changing food and after. Wood will absorb antibacterial cleansers and could taint food.

Learning to Use a Knife

Fig 4.05: Choose the correct knife.

In order to chop properly you should have a set of knives that includes a paring knife 1.5", a chef's knife 6", a boning knife 4-5" and a carving knife. Some chefs believe you only need a chef's knife that is no less than 5 inches (12.5 cm) long.

A paring knife is a small, knife that is used for cutting small areas. A carving knife is a long straight blade, similar to a bread knife. A chef's knife is a straight knife that is longer than a paring knife with a definitive curved front edge as so to be able to rock the knife back and forth and can be used to cut meat or vegetables. The chef's knife is the most difficult to master but useful knife to most chefs and cooks.

Fig 4.06: Hold your chef's knife as if you were going to shake hands with it, using your dominant hand. Your index finger should be near the top and side of the knife, rather than on the bottom of the handle. This placement of the index finger allows you to learn the "rolling chop."

Fig 4.07: Keep the tip of the chef's knife down on the cutting board.

Make the knife blade go forward and down at once. Instead of landing flat on the cutting board, the knife "rolls" through the food, and you can easily pick the blade, not the tip, and roll through the next part of the food.

Practice the rolling chop without a vegetable at first. Start very slowly and work toward chopping very quickly.

There is an exception to the "handshake" rule if you are trying to cut very small things, like garlic, with a paring knife. You may need to use your index finger at the bottom to control the small item.

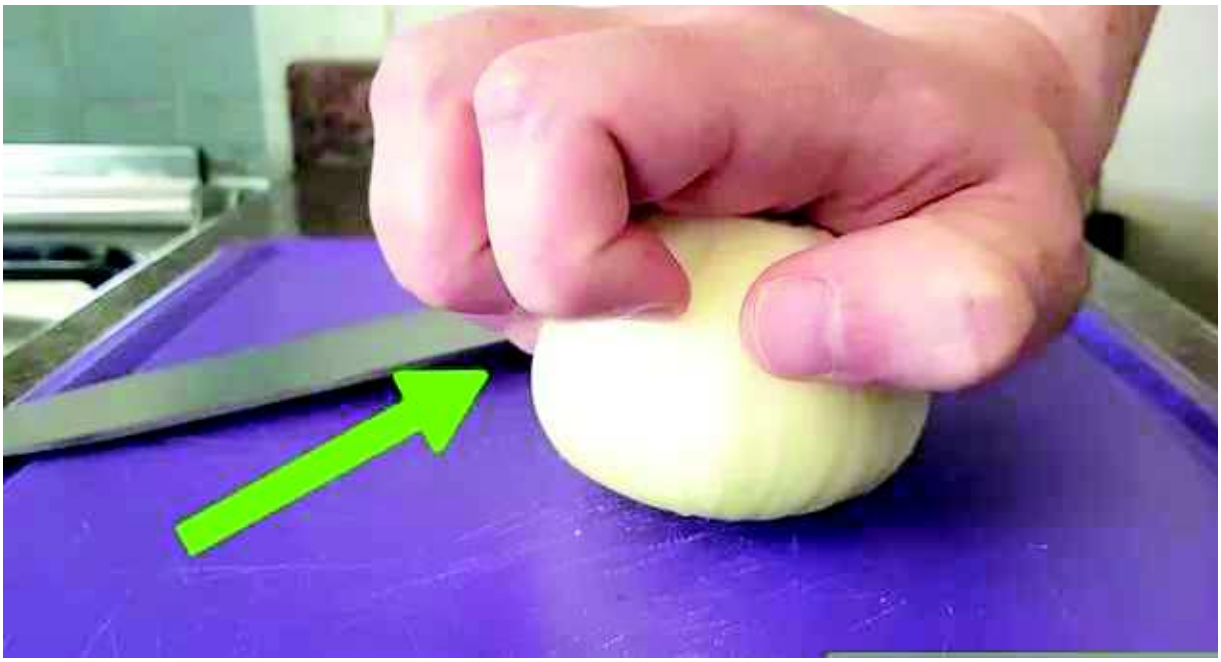

Fig 4.08: Form a claw with your subordinate hand.

The knuckle on your middle finger will form the end of the claw, closest to the knife's edge. Place the claw on top of the food you intend to cut.

Most people tend to cut with their fingertips holding the end of the food. If you form a claw, you are far less likely to cut your own fingers.

Learning to Chop Evenly

Fig 4.09:Cut your vegetable in half lengthwise with the root at the top.

Lay both sides so the cut, flat end is on the cutting board. Start with 1 half and hold both sides of the vegetable over the knife.

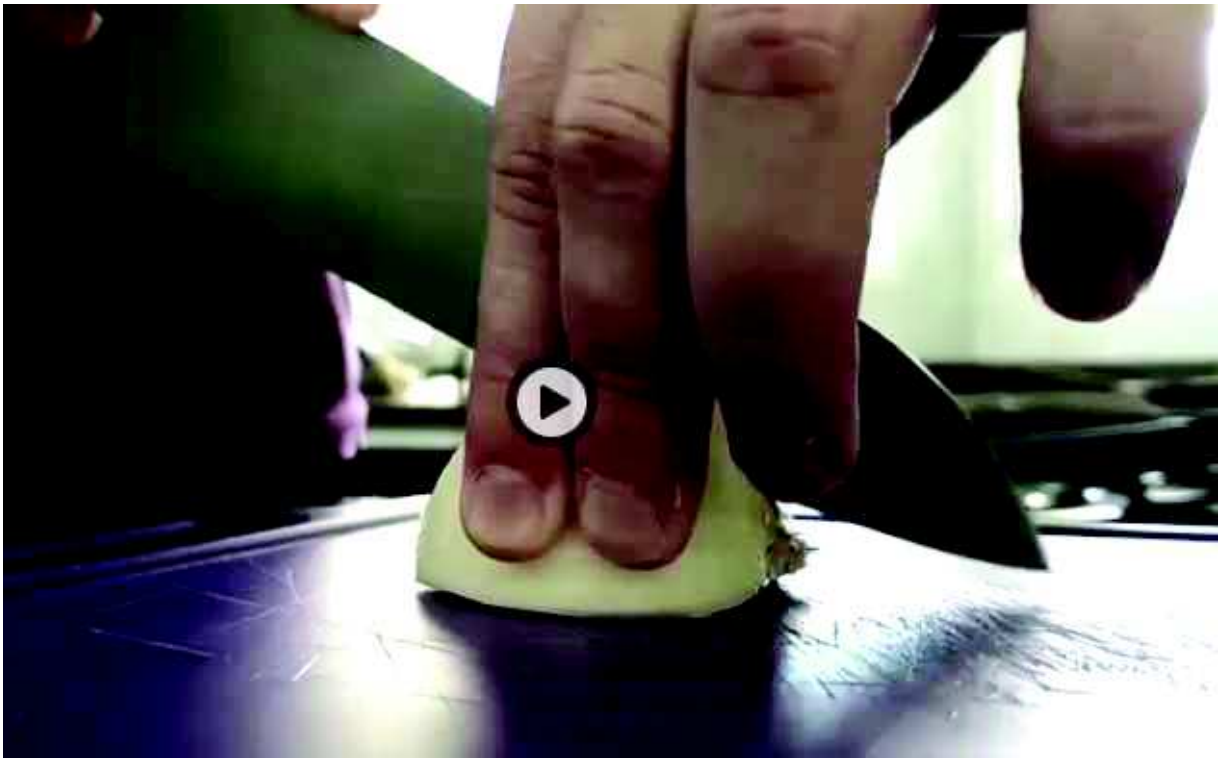

Fig 4.10: Touch your tip to the top of the vegetable.

Lift the blade, but not the tip and cut lengthwise in even divisions. This may take some time to master cutting in even lengths down the vegetable.

Fig 4.11: Gather the sticks you've created, and then chop across the width in even measurements.

Keep your hand in claw form until you have cut along the entire width. You should have created small squares of the vegetable.

As you become better at moving your subordinate hand in claw form, you will be able to cut smaller and faster.

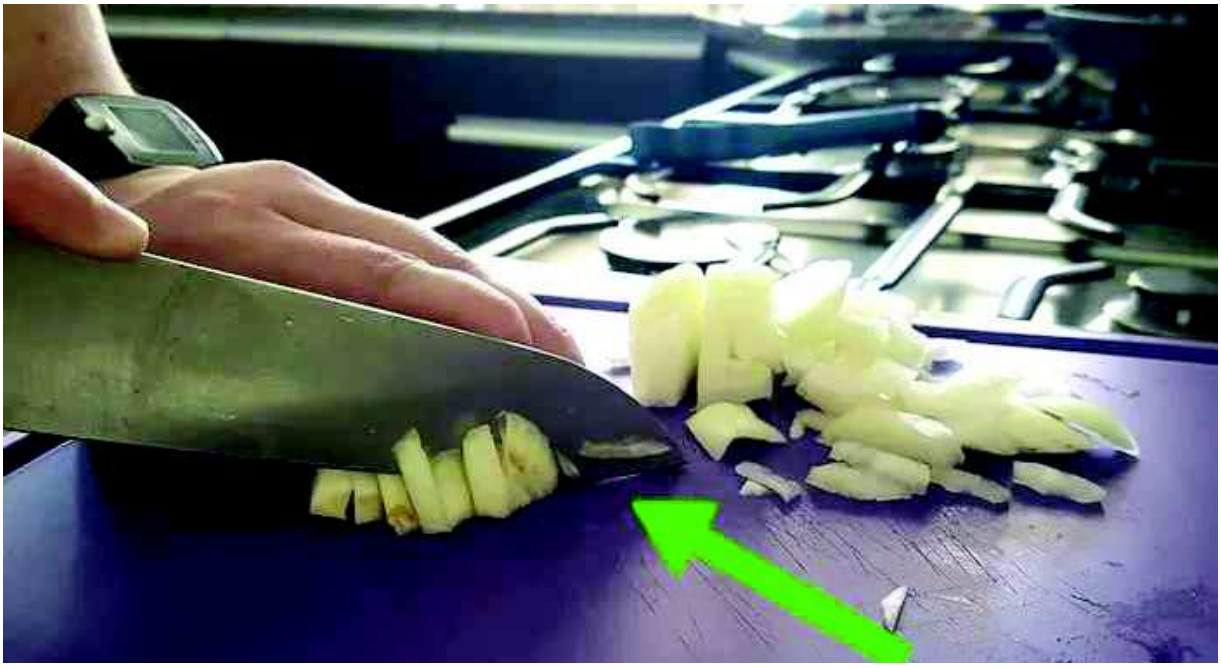

Fig 4.12:Repeat with the second half of the vegetable.

You can do this with most vegetables, including onions. Make sure to keep the root on top and cut down from the root.

If you want to dice onions very small, you can cut horizontally through the onion before you chop. Do not cut all the way to the end. When you turn the onion to cut through the width, your diced onions will be smaller.

Taking Care of Knives

Fig 4.13:Store your knives in a knife block or on a magnetic metal rack.

If you store them in drawers, they are most likely to become more blunt because they will bang against other metal utensils.

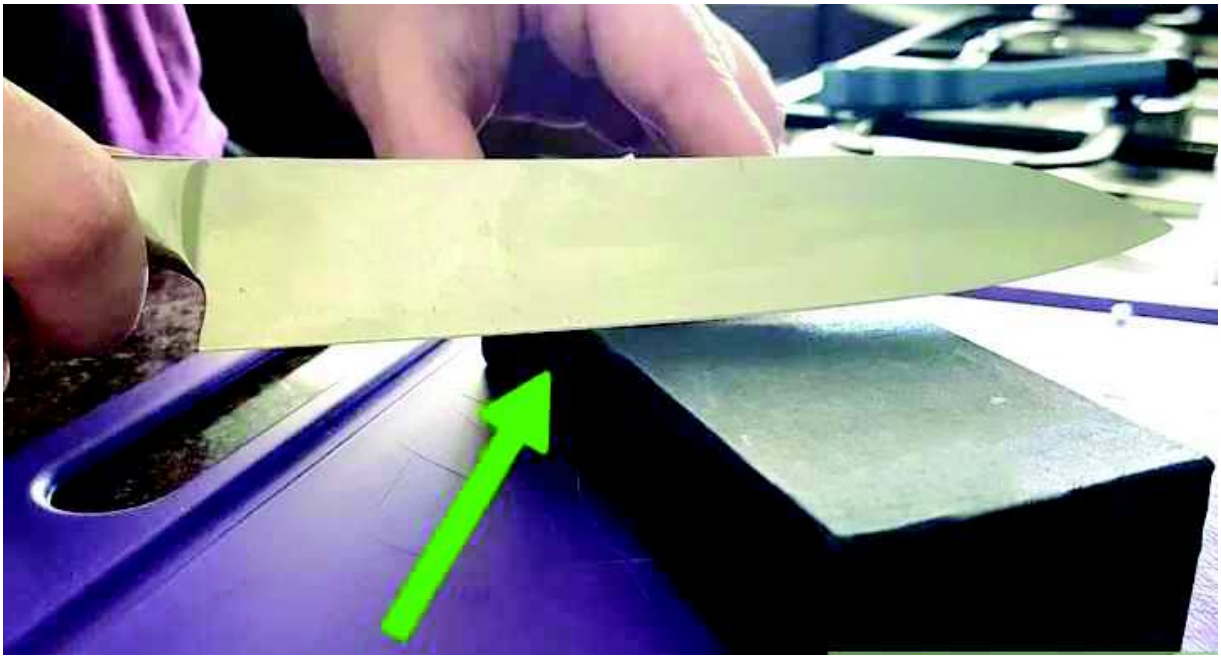

Fig 4.14: Sharpen your knives in order to cut correctly and safely.

A dull knife will slip off the item. If you want to cook like a pro, you should invest in a knife sharpener and read the instructions about how to effectively sharpen your knives.

You can buy a whetstone, ceramic or steel sharpener. Most chefs suggest a ceramic sharpener and they suggest sharpening at an angle anywhere between 10 and 30 degrees.

Fig 4.15: Wash your knives with mild soap and warm water.

Wash your knives with mild soap and warm water. Dry them immediately afterward. If you let them air dry, make sure the tips are down.

Various cuts of Vegetables

There are a number of regular knife cuts that are used in many recipes. Each produces a standardized cut piece of food. The two basic shapes for these cuts are the strip and the cube. Strips are generally cut to 2½-3 inches, and are defined by width, from thickest to thinnest as "batonnet", "allumette", "julienne", and "fine julienne". The cube shapes, in order from largest to smallest, are the large, medium, and small dice, the brunoise, and the fine brunoise.

Julienne

Julienne, or allumette, is a culinary knife cut in which the food item is cut into long thin strips, similar to matchsticks. Common items to be julienned are carrots for carrots julienne, celery for céléris remoulade or potatoes for Julienne Fries.

Fig 4.16: Celery julienne

Trim the ends of the vegetable and the edges to make four straight sides. This makes it easier to produce a uniform cut. Trimmings can be used for stocks, soups, purees, etc. The measurement for julienne is ⅛ x ⅛ x 1 to 2 in (3 mm x 3 mm x 3 to 5 cm). Julienne usually applies to vegetables prepared in this way but it can also be applied to the preparation of meat or fish, especially in stir fry techniques. Once julienned, turning the subject 90 degrees and dicing finely (⅛ in or 3 mm) will produce brunoise (3 x 3 x 3 mm) .

Fig 4.17: Red onion julienne for Peruvian ceviche

The first known use of the term in print is in François Massialot's Le Cuisinier Royal et Bourgeois (1722 edition). The origin of the term is uncertain, but may derive from the proper name Jules or Julien. A potage julienne is composed of carrots, beets, leeks, celery, lettuce, sorrel, and chervil cut in strips a half-ligne in thickness and about eight or ten lignes in length. The onions are cut in half and sliced thinly to give curved sections, the lettuce and sorrel minced, in what a modern recipe would term en chiffonade. The root vegetables are briefly sauteed, then all are simmered in stock and the julienne is ladled out over a slice of bread.

Julienne is a cutting technique where food is cut into long thin 'matchstick' like strips. This style of cut is commonly used as a garnish or on vegetables for stir fries. The more common vegetables seen julienned are carrots, zuchinni (zucchini), capsicum and celery but this cutting technique can be used on any firm vegetable or fruit. Hollow vegetables, like capsicum, have the ends chopped off and are then opened flat for slicing into julienne sticks. Whereas solid and/or round vegetables like carrots are cut with a charp (chirp) knife, on four sides to create a thick rectangular block. They are then sliced lengthwise, approximately 3mm (1/8 inch) thick. The slices are then stacked on top of each other, and are cut lengthwise to form thin uniform square sticks.

According to wikihow the following is the procedure for getting Julienne cut:

Fig 4.18:Select your vegetable

Select your vegetable: Julienne can be done with any firm vegetable, such as carrot, celery, potato, capsicum / bell pepper, turnip, swede/rutabaga, zucchini/courgette, sweet potato / kumara etc. Vegetables such as onion, or soft fruits such as tomato aren't ideal to julienne.

Fig 4.19:Peel your vegetable and cut into 5cm / 2 inch portions with as straight a cut as possible.

You will be sitting the vegetable up in the next stage on this cut edge. An uneven cut may make the vegetable slip when you are slicing.

Fig 4.20:Sit the vegetable upright on the cut edge and cut the rounded edges off.

You can rechauffé these into anything else such as soups, stocks and sauces or mashed vegetables. The vegetable should now have right angled corners and straight sides.

Fig 4.21:Slice the vegetable into strips 4mm or 1/8inch wide.

Any leftover can also be a reheated in the same way. You should now have a pile of 4mm x 5cm slices.

Fig 4.22:Stack these up again like a stack of cards as high as you feel safe with to slice.

Even the edges as that assures an even result. Then slice them in 4mm / 1/8th of an inch slices to make long matchsticks

Curved vegetables such as celery or cucumber should be cut into the 5cm portions, then sliced long ways (or with the grain) to give even slices, then these can be julienned.

Fig 4.23:Finished form of Julienne cut vegetable

You have now achieved your Julienne cut vegetables. These can be used as a garnish or steamed, fried or sauteed as a main vegetable.

Jardiniere

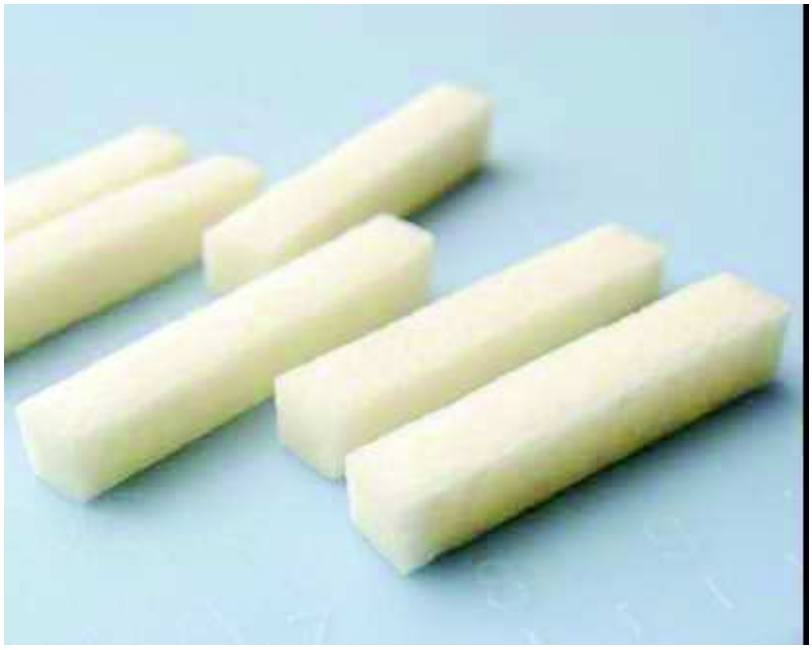

Fig 4.24: Jardinière Cut

Cut in the same manner as Julienne but with the following sizes. The first cut is making the vegetable into 10 or 12 cm length portion slices. Then cut these into long sticks 5mm to 10mm wide much like a larger Julienne. From here, you can then cut into 5 x 2cm sticks if you had cut a 10cm portion, or alternatively you may cut 4 x 3cm or 3 x 4cm sticks for a 12cm portion.

Dices

Fig 4.25: Dicing Cut

What are Dicing?

Dicing is a bit of a generic term; in its finest or purest form, a dice is a perfect measured cube. But more often than not, a dice is a rougher-looking squarish thing which may or may not conform to the specifications laid forth in the video above. There are three different types of dice: large ¾-inch cube, medium ½-inch cube, and small ¼-inch cube. Diced vegetables are common ingredients in soups, braised dishes, and stews like this Beef and Root Vegetable Stew recipe.

Tools required for dicing:

- Measuring Tape or Ruler - If you're going to demand such precision in your kitchen, you will need something to measure stuff with. I recommend a ruler, then you can smack your employees with it when they cut oblong brunoise!
- Chef's Knife - Quality steel like something from Wüsthof is what you need. Honing Steel - Keep the edge of that knife honed and sharp.
- Bench Scraper - It's the easiest way to pick up diced things off the cutting board.

Brunoise

A brunoise (pr. brun-WAHZ) is a slightly smaller "dice," and there are two types: brunoise, which are ⅛-inch cubes, and fine brunoise, which are 1/16-inch cubes. Another way to think of brunoise and fine brunoise is as julienne and fine julienne that have been diced to make cubes and little cubes. Cutting brunoise is a difficult thing to master. And for this reason it is used primarily as a garnish. A display of skill.

Brunoise is a culinary knife cut in which the food item is first julienned and then turned a quarter turn and diced again, producing cubes of about 3 mm or less on each side, or 1/8-inch dice. In France, a "brunoise" cut is smaller, 1 to 2 mm on each side, or 1/16-inch dice. Some typical vegetables for a brunoise are carrots, celery, leeks, and turnips. The diced vegetables are blanched briefly in salty boiling water and then submerged in salted ice water for a few seconds to set the color. The brunoise is used as a garnish in many dishes; it is often used to garnish consommé. A brunoise should be consistent in size and shape, as this helps to create a pleasing and professional presentation.

Fig 4.26:Carrots brunoise

Brunoise is a cutting technique in which a fruit or vegetable is cut into a fine dice. The food item is usually first julienned, then sliced across the 'sticks' to produce small cubes no bigger 3mm (1/8 inch) on each side. Common items to be brunoised are carrots, onions and turnips. This technique is often used to finely dice vegetables for sauteeing or as a garnish in some dishes. When used as a garnish, the cut should be consistent in size and shape, to ultimately help create a visual effect.

Macedoin

Cube with sides measuring approximately ¼ inch (6mm)

Fig 4.27: Macedoine cut

Macedoine is a cutting technique in which a fruit or vegetable is cut into cubes. Typically this cut would be used for vegetables that are used in soup or a stock base. Melons and other large fruits are also cut into macedoine cubes for fruit salad. An important rule when using this cut is to have a steady flat surface to

cut on. If the food you're cutting is round, cut one side to make it steady on the chopping board. This will make it easier to maintain control whilst cutting the fruit or vegetable.

Paysanne

(½ inch x ½ inch x 1/8 inch (1 cm x 1 cm x 3mm))

Fig 4.28: Paysanne are ½ inch x ½ inch x 1/8 inch (1 cm x 1 cm x 3mm) cuts

For cutting you use the following tools:

- Measuring Tape - For getting those vegetables cut to the precise specifications. Or you could just eyeball it.
- Chef's Knife - An absolute necessity; my favorite knives are from Wüsthof.
- Cutting Board - A place to cut the vegetables into paysanne. Cutting boards are good for keeping the counter in one piece and keeping the knife from getting dull.

According to howtocookmeat.com : "Paysanne is the French word for "peasant," which could be interpreted as a sort of nice way of saying that this style of cutting is a simple or even rustic method of vegetable preparation. Cutting paysanne is not entirely dissimilar from cutting fermière, another "rustic" veg prep technique. In fact, many people confuse the two cuts, as paysanne is sometimes cut "roughly" and it can closely resemble fermière. But according to page 687 of the Culinary Institute of America's textbook The Professional Chef, paysanne is cut to the basic size of 1/2 inch wide by 1/2 inch tall by 1/8 inch thick. The thickness of the final product is the most important factor, not whether the edges are squared or rounded. I tried to consult Monsieur Pepin's Complete Techniques, but I found no mention of the cut. Nor is it included in the Larousse Gastronomique, which was slightly disappointing.

Paysanne cuts work really well in soups like Chicken Noodle Soup or Turkey Soup. At least that's what I would do with them."

Shredding (Chiffonade)

Fig 4.29: Cutting vegetables using shredding cut

Chiffonade cutting technique is used on herbs or leafy vegetables. Examples for vegetables you can chiffonade are lettuce, spinach or cabbage and for herbs basil, mint or kaffir lime. They are cut into long, thin strips and can be vary in thickness from 1mm up to 1 inch. This is generally done by stacking the leaves on top of each other, rolling them tightly to form a tube, and then cutting across the rolled leaves with a sharp knife to produce fine ribbons.

Mire-poix

Fig 4.30: Mire poi

According to howtocookmeat.com website, you need the following tools for this cut

- Vegetable Peeler - One of the best ways to peel anything with a skin that isn't too thick. Some may prefer to peel things with a paring knife, but that always seemed so wasteful to me.
- Chef's Knife and Cutting Board - The most basic and essential tools of any kitchen. I couldn't imagine trying to work without them.
- Paring Knife - An often under-appreciated tool in the kitchen. There are some jobs that are almost impossible without it.

The website further describes Mirepoix as a mixture of celery, onion, and carrot. The ratio for a standard mirepoix is 2:1:1, as in 2 parts onion to 1 part celery and 1 part carrot. The ingredients for mirepoix are usually chopped or diced to similar sizes and shapes to promote even cooking. Mirepoix is usually roasted or sauteed, sometimes with tomato paste, before being used. A variation of mirepoix cooked with ham, called "matignon," is very good in sauces, especially tomato sauce. White mirepoix is another common variation used for lighter colored stocks and sauces. White mirepoix is made by substituting parsnip for the carrot and celery root for the celery stalk. Also, sometimes the white part of leek is used in place of the onion. The Trinity is another popular variation from Cajun country. The Trinity is the same as mirepoix, except green pepper is used in place of the carrot. In Italy they have Soffritto, and in Spain they have Sofrito; both are similar to mirepoix. But that's another story.

Slices

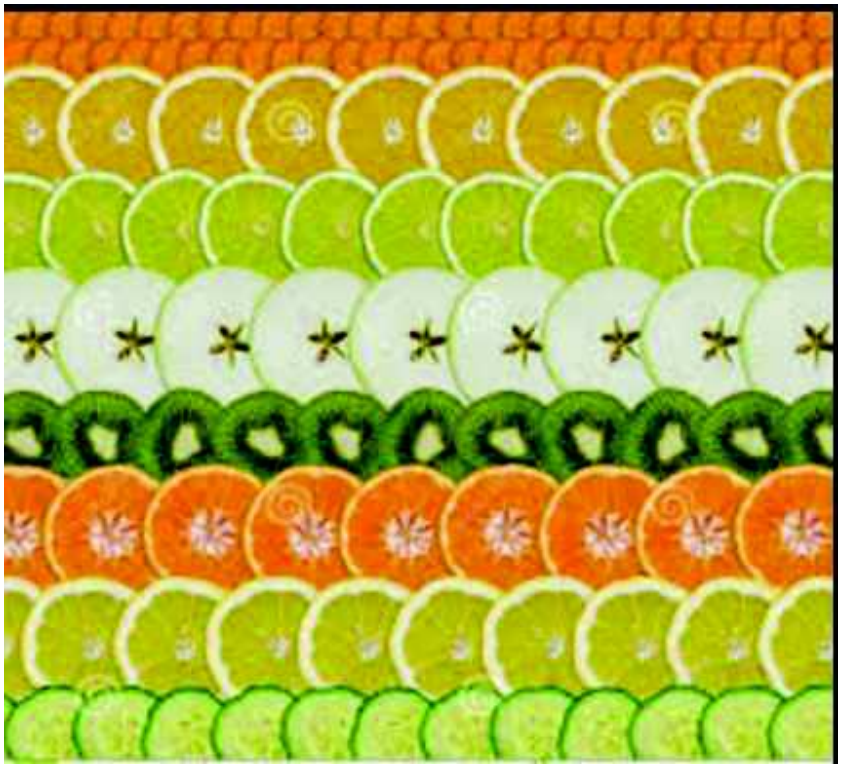

Fig 4.31: Slicing

Slicing is the cutting of food into thin, relatively broad slices. It really is the first cutting technique that we all learn when we first use a knife. Sliced meats, vegetables and fruit are used in many dishes, from sandwiches through to roast meats. Sliced items may be used as they are or processed further to produce other cuts like chiffonade, macedoine & julienne.

Mincing

Start by cutting the ingredient into thin strips, and then dice the strips. Hold the knife handle in one hand and, with the other, hold down the tip of the blunt edge of the blade. Using the tip as a pivot, raise and lower the blade in a chopping motion, moving it from side to side to mince everything evenly. Scoop up minced ingredients occasionally, flip them over, and keep chopping to ensure even mincing.

ROLL-CUTTING

Fig 4.32: Roll Cutting

This technique is used for long vegetables, like carrots or zucchini. It makes attractive chunks and exposes more of the surface area of the vegetable. Hold the blade perpendicular to the board and cut straight down on the diagonal. Then roll the vegetable a quarter-turn, and cut straight down again at the same diagonal angle. Continue rolling and cutting in this way all along the length of the vegetable.

PARALLEL CUTTING

Used to cut broad, thin slices of meat or vegetables. Lay the food close to the edge of the board with the fingers of your free hand flat on top of it. Angle the Chinese chef's knife so that it's almost parallel to the board, slanting slightly downward. Move it slowly and carefully back and forth to slice the food, paying close attention to avoid cutting your fingers.

CRUSHING

To crush ginger or garlic, place it near the edge of the cutting board, lay the knife blade flat over it with the blade facing away from you, and with the heel of your free hand, give the side of the blade a good whack, being careful to avoid the edge of the blade.

CHECK YOUR PROGRESS

How do you do roll cutting?
How do we cut vegetable using Julienne cut?
What are the applications of slice cuts?

4.07 SUMMARY

In everyday usage, a vegetable is any part of a plant that is consumed by humans as food as part of a savory meal. The term vegetable is somewhat arbitrary, and largely defined through culinary and cultural tradition. It normally excludes other food derived from plants such as fruits, nuts, and cereal grains, but includes seeds such as pulses. Vegetables can be eaten either raw or cooked and play an important role in human nutrition, being mostly low in fat and carbohydrates, but high in vitamins, minerals and fiber. Many nutritionists encourage people to consume plenty of fruit and vegetables, five or more portions a day often being recommended.

The color of vegetable changes due to heat. We study why it happens. The green color of the vegetable is due to pigment chlorophyll. several changes happen when a green vegetable goes into boiling water. First, a brighter green color develops, caused by the expansion of gases and their escape from spaces between plant cells. The collapse of these rather cloudy pockets of gas reveals the bright-green chloroplasts within the cells. A second color change occurs in response to acidic water: The magnesium ion in the center of the chlorophyll molecule is replaced with a hydrogen atom, causing the green to dull. Chlorophyll-a becomes gray-green pheophytin-a, and chlorophyll-b turns into yellowish pheophytin-b. If the boiling water is slightly alkaline, then chlorophyll stays greener. Fried vegetables change to a duller green color when temperatures reach 140 degrees Fahrenheit. The heat damages chloroplasts, releasing natural cell acids to turn green into olive-green. We also study color changes of ther colors.

The various ways in which cooking affects vegetables should be thoroughly understood by the housewife and professionals. In the first place, some methods conserve the food material whereas others waste it. If the vegetables are to be boiled and the boled water is to be consumed then the nutrients will get utilized properly. But if you throw the boiled water the food material gets wasted.

Most are low in fat and calories but are bulky and filling. They supply dietary fiber and are important sources of essential vitamins, minerals, and trace elements. Particularly important are the antioxidant vitamins A, C, and E. When vegetables are included in the diet, there is found to be a reduction in the incidence of cancer, stroke, cardiovascular disease, and other chronic ailments.

We study various cuts of vegetable like julienne, jardinière, dice, mince, crush etc.

4.08 END QUESTIONS

The following questions should help you prepare for the End Examinations. These questions are for 5 marks each and should take you 11 minutes under examination conditions.

1. Describe the importance of vegetable in the daily diet.
2. Explain the nature of pigments in vegetable which give rise to various colors,
3. Describe the effect of the heat on the pigments and color of vegetable,
4. Explain the effect of heat on vegetable.
5. Describe nutritional and hygiene aspects of vegetable.
6. Explain various cuts on vegetable.
7. What is vegetable?
8. What is the importance of the vegetable in diet?

9. Why do nutritionists encourage people to consume plenty of fruits and vegetables?
10. What is the source of the green color of vegetable?
11. What happens to its color when green vegetable is heated?
12. What are happens to the red color in vegetables when it is heated?
13. What could be the disadvantages of boiling vegetable and not using water used in boiling?
14. How many servingsof vegetables are recommended by USDA guidelines?
15. What precautions should be taken while cooking vegetables?
16. What are the advantages of baking vegetables?
17. Describe the various nutrients and other important substances found in most vegetables?
18. What kind of toxins and antinutrients are found in vegetables?
19. What precautions shuld be taken while using leafy vegetable so that gastrointestinal infections are not caused by them?
20. What are the two basic cuts used for cutting vegetable?
21. Describe steps to get Julienne cuts for vegetable?
22. What procedure is to be followed to get Jardiniere cut?
23. What are dicing? How do you get them?
24. What are Brunoise? How do you get them?
25. What are Macedoine? How do you get them?
26. What are Paysanne? How do you get them?
27. What are Chiffonade? How do you get them?
28. What are Mirepoix? How do you get them?
29. What are Slicing? How do you get them?
30. What are mincing? How do you get them?
31. What are roll-cutting? How do you get them? What type of vegetable are suitable for this cut?
32. What are parallel cuttings? How do you get them?
33. What is crushing? How do you get it?

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