gel consistency, and gelatinisation temperature. Kernel elongation without significant increase in breadth and possess pleasant aroma which are ideal for making pulav.

Aromatic rice: Aromatic rice varieties contain acetyl 1-1 pyrroline as the major aroma principle while cooking. These are characteristic of the rice variety. Non-aromatic rice varieties can be flavoured by adding one or two fresh leaves of *Pandanus latifolius* while cooking as they contain 2-acetyl 1-1 pyrrole.

If the bran is subjected to a short term high temperature after milling, the lipase activity is destroyed and stabilized bran of edible grade is produced. Bran produced from parboiled rice is already stable and does not require any further stabilization treatment.

Stabilized or parboiled food grade rice bran is normally finely granulated light tan in colour and it has bland flavour and can be used in preparation like bread, snacks, cookies, and biscuits. In addition rice bran is a very rich source of dietary fibre so it is an effective stool bulking agent.

Table 2.7: Nutritive value of rice bran per 100 g

Nutrient	*Amount*	*Nutrient*	*Amount*
Energy (kcal)	393.0	Riboflavin (mg)	0.48
Protein (g)	13.5	Niacin (mg)	29.8
Carbohydrate (g)	48.4	Calcium (mg)	67.0
Fat (g)	16.2	Iron (mg)	35.0
Thiamin (mg)	2.7	Fibre (g)	4.3

Parched rice products: About 4–5 per cent of total supplies of rice in India is converted into rice products—parched rice, parched paddy and rice flakes.

Parched rice: Parboiled rice is soaked in salt water to increase the moisture to about 20 per cent. Parched rice is prepared by throwing rice in sand heated to a high temperature in iron or earthen pan. On stirring rice begins to crackle and swell. Then the contents of the pan are removed and sieved to separate the parched rice from sand. Parboiled rice is used in making parched rice. Parched rice is a crisp product with a greyish to brilliant white colour and is sold either salted or unsalted. It is eaten as such or mixed with buttermilk and then consumed.

Parched paddy or puffed rice: Sun ripe paddy is filled in earthen jars and is moistened with hot water. After 2–3 minutes, the water is decanted and the jars are then kept in an inverted position for 8–10 hours. The paddy is exposed to sun for a short time and then parched in hot sand 190–210°C for 40–45 sec. During parching, the grains swell and burst into soft white product. The parched grains are sieved to remove sand and winnowed to separate the husk.

Flaked rice: Flaked rice is made from parboiled rice. Paddy is soaked in water for 2–3 days to soften the kernel followed by boiling water for a few minutes and the water is drained off. The paddy is heated in a shallow earthen vessel or iron pan till the husks break open. It is pounded by an iron pestle or use iron roller which flattens the kernel and removes the husk. The husk is separated by winnowing. Flaked rice is thin and papery and of white colour.

Advantages of parched rice products:

- Easily digestible and hence good for children and old people.
- Readily available to eat due to faster cooking.
- It adds variety in the diet.
- Since iron pans are used, iron content is increased.
- Improves flavour and texture.

Basmati rice: Basmati rice has its origin in the foot-hills of the Himalayas. When cooked, it is nonsticky and soft. Basmati grain quality components are intermediate amylose content, intermediate

Rice products

Rice starch: Rice starch granules are quite small and are embedded in a protein matrix. To separate them from protein, broken rice is steeped for 24 hours in 5 times its weights of 0.3 per cent caustic soda. The caustic soda treated granules are washed, dried and ground into flour. The flour is then mixed with about ten times its weight of caustic soda solution. This removes gluten. After 24 hours, the starch that settles down is removed, washed and dried. Rice starch is used in puddings, ice-creams and custard powder. It forms a tender opaque gel.

Rice bran: Bran includes several sublayers within the pericarp and the aleurone layer. Breakage of the white rice kernel during milling also results in small fragments of the endosperm becoming part of the bran fraction. These broken fragments are primarily starch and normally contain 10–12 per cent of bran.

Malted wheat: The process of malting consists of the following steps:

- Good quality grain is steeped in cold water for 36 hours in warm climate with two or three changes of water.
- The steeped grain is spread on wire mesh trays of 2–3" thickness which are kept in a stand. The germination is allowed to proceed for 3 days in a warm climate. During germination amylases and proteases are formed.
- Germinated grain is allowed to slow dry during which the amylases act on starch, hydrolysing them. The drying should be at a low temperature to conserve as much of the enzyme activity as possible. During drying, the water-soluble carbohydrates and nitrogen (peptones and peptides) increase. The characteristic malt flavour is developed. The malt is dried to a moisture content of about 13 per cent.

Amylase Rich Food (ARF) is germinated cereal flours which are extremely rich in the enzyme alpha-amylase. Just tiny or catalytic amounts of any germinated cereal flour can instantly liquefy or reduce the dietary bulk of any viscous multi-mix gruel provided cereal flour is the main ingredient. The alpha-amylase cleaves the long carbohydrate chains in the cereal flour into shorter dextrins. Just half a flat teaspoon of any ARF can reduce even a very high total solid concentration of 45 g made up of 25 g flour, 15 g sweetener and 5 g oil cooked in 100 ml of water to a soupy consistency. This remarkable property makes it possible to offer the weaning child a low viscosity yet high energy dense preparation.

Malted cereal flour is inexpensive and can be made at home as well as commercially. Malt is used in brewing and in the preparation of malt extract for pharmaceutical purposes and in the preparation of malted milk powder.

Glutamic acid: It is derived from wheat. A familiar compound of glutamic acid is "mono sodium glutamate", a salt-like product generally available and used to bring out the flavour of other foods or seasonings.

Wheat germ: Wheat germ is about 2–3 per cent of wheat grain. It has a high nutritional quality, comparable to animal proteins. Presently this germ is not separated during milling, as it has a poor shelf life of only a few days and is lost in bran fraction. Commercial germ samples contain 25–30 per cent protein, 9–11 per cent oil, 10–15 per cent sugars. Toasting or steaming of the germ increases the shelf life: Germ can be used in bakery products and in weaning foods.

Wheat bran: It increases the stool weight by increasing the water holding capacity of the bran. Wheat bran prevents constipation and may lower the risk of colon cancer.

Triticale: It is a hybrid cereal from a cross between wheat (Triticum) and rye (Secale). The hybrid cereal has the productivity and disease resistance of wheat with the vigour and hardiness of rye. The protein of triticale has a higher lysine content than that of wheat protein. The grains have

Table 2.5: PFA standards for wheat and wheat products

Standards	*Atta*	*Maida*	*Rava*
Moisture maximum per cent	14.0	14.0	14.5
Total Ash maximum per cent	2.0	1.0	1.0
Ash insoluble in dil. HCl per cent	0.15	0.1	0.1
Gluten minimum per cent	6.0	7.5	6.0
Alcoholic acidity as H_2SO_4 per cent	0.18	0.12	0.18

Products of wheat

Whole wheat flour: (It contains the finely ground bran, germ and endosperm of the whole kernel. Whole wheat products have a distinctive flavour and coarser texture than those made from white flour. Because of the higher fat content of the germ, whole wheat flour is more difficult to keep and sometimes becomes rancid in storage under poor conditions.

Wheat flour is fortified with defatted soya flour 'Poushtic atta' maximum upto 10 per cent. This not only improves quantity and quality of protein but also improves functional characteristics such as moisture retention and less oil absorption in the end product.)

Iron fortified wheat flour has been successfully used to prevent iron deficiency anaemia in some western countries. The study conducted at NIN (1998–99) revealed that ferrous sulphate is a cost effective and good source of iron in the process of wheat flour fortification.

Maida: The bran and germ are separated in making white flour or maida. Maida bakes more uniformly into a loaf of a greater volume and it is more bland in taste and more easily digested. It can be stored in an air-tight container in a refrigerator.

Semolina: It is coarsely ground endosperm and its chemical composition is similar to that of white flour. It is used in the manufacture of macaroni products. It is roasted before storing to save it from insects and worms.

Macaroni products: These products are also called pasta or alimentary pastes. These products include macaroni, spaghetti, vermicelli and noodles. The main ingredient in the macaroni group of products is a special durum flour of high-gluten content. Durum wheat is used because of its yellow-amber colour, nutty flavour and also because they hold their shape and firm texture when cooked.) The starchy endosperm of wheat is coarsely ground into semolina which is made with water into a thick dough. The dough is placed in a cylinder, the lower end of which is fitted with a disc perforated with openings and as the dough is forced through the openings various shapes are formed. Macaroni is a tube form, spaghetti may be either tube or rod, vermicelli is a tiny rod and noodles are flat strips. Pasta products are also available in the shapes of shell and alphabets. Usually not less than 5.5 per cent by weight of egg solids are added to noodles.

FISH AND HEALTH

Eskimos living in Greenland as also the fishing community in Japan, whose daily consumption of fish is 250-400 g enjoy complete freedom from cardiovascular diseases. The beneficial effect of dietary fish is attributed to the fatty acid composition of the fish.

In white fish, any fat present in the fish is stored in the liver. Only minute traces are found in the flesh. Most of the white fish are sea-water fish and live an the seabed. In oily fish, fat is distributed through the flesh in the muscle fibres. The amount of fat may vary from 8 per cent to 15 per cent.

Minerals: Fish is rich in calcium particularly small fish when eaten with bones. Marine fish or ocean fish are good source of iodine, selenium and fluoride. Selenium is a powerful anti oxidant. Oysters are good source of copper and iron. Sodium content of freshwater fish is slightly less than meat. Shell fishes such as oysters are among the nature's richest source of zinc. The bioavailability of iron and zinc is higher than from plant food.

Sometimes, tile fish, mackerel, swordfish, and shark may get contaminated with mercury which is toxic to the body.

Vitamins: Sea foods contain significant amounts of vitamin B_{12} especially shell fishes. Fish liver oils are excellent source of fat-soluble vitamins. Shark liver oil contains 10,000-24,000 IU of vitamin A per gram of oil. Rohu contains vitamin C. Fish are good source of niacin and vitamin D. Sea foods contain significant amounts of vitamin B_{12} especially shell fishes.

Fish protein concentrate: It is the name given to edible fish product suitable for human consumption prepared from fresh fish. The fish protein concentrate, an essentially odourless powder is very rich in protein—70-80 per cent with high lysine content. It has high biological value protein. It is light in colour, free from grittiness and can be incorporated at 3-10 per cent in a variety of dishes to supplement daily diets.

Fish protein foods developed are fish protein concentrate, non-deodourised fish flour, fish protein enriched corn starch, fish cakes, fish potato flakes, fish sausage and fermented fish products. These products can easily be incorporated into any snacks.

SELECTION

Fish that are fresh can be easily identified by noting the following qualities:

- The skin looks bright, moist and shiny. The scales should be firmly attached to the skin. The skin on stale fish may show signs of wrinkling and shrinking away from the flesh.
- The eyes of a freshly caught fish will be convex, the pupil black and the cornea translucent. The eyes should be bright, clear and bulging and not sunken.
- The gills of freshly caught fish are bright red, but as the blood in them oxidises they rapidly turn brownish and any mucus on them turns opaque.
- If fish is split along the backbone and lifted, the bone should stick firmly to the flesh. If the bone separates easily, the fish is stale.
- The surface should be free of dirt and slime.
- The flesh should be firm to touch with no traces of browning or drying around the edges.

Fat: Fish contains less amount of fat compared to meat and poultry. The lipid content of both fish and prawns is very low and varies within a very narrow range of 1–2.8 per cent. Crab small contains nearly 10 per cent fat. Vanjaram contains 4 per cent fat. Fish contains saturated fatty acids (40 per cent) monounsaturated fatty acids (25 per cent) polyunsaturated fatty acids (n-3–25 per cent, n-6–10 per cent). Fresh water fish contains eicosapentaenoic acid and decosahexaenoic acid which are n-3 poly-unsaturated fatty acids. n-3 fatty acid content of some fish is given in Table 7.7.

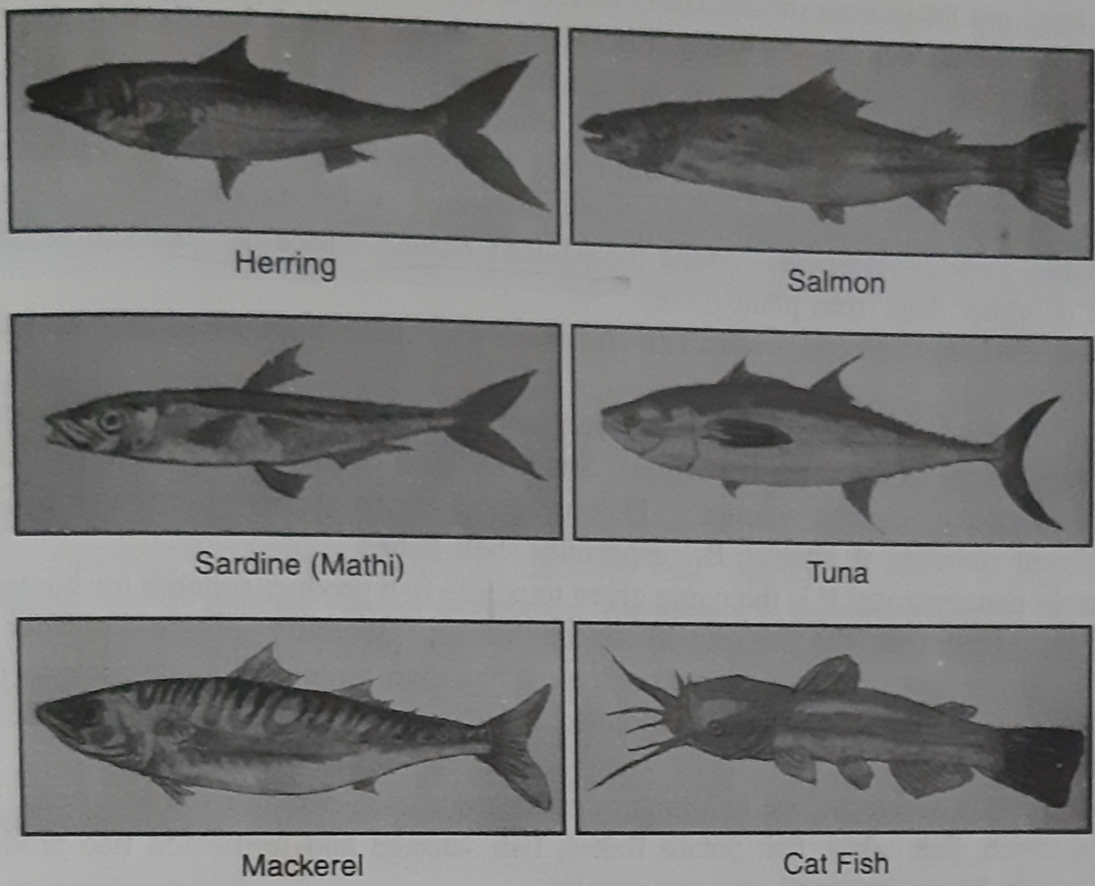

Figure 7-c: Kinds of fish.

Table 7.7: n-3 fatty acid composition of some fish

Fish	*Amount g/100g*
Fresh water fish	0.07 to 0.28
Murrel	0.28
Pearl sport	1.7
Mackerel	0.39
Prawn	0.3

n-3 fatty acids protect against cardiovascular disease and essential for the development and function of brain and prevent inflammation and pain of arthritis.

COMPOSITION AND NUTRITIVE VALUE

The composition of fish varies. Nutritive value of various fish is given in Table 7.6. Fish are not good source of energy because they are not good sources of carbohydrate and fat.

Carbohydrate: The shell fish has less fat and more carbohydrate than fin fish. Like meat, fish contain some glycogen in muscle tissues. In the live fish, glycogen is the source of stored energy. Oysters are notable for their high content of glycogen, on an average of 2-3 per cent.

Commonly consumed fish are carp, rohu, sardine, mackerel pomfrets, seer fish, prawns, ribbon fish sole, Bombay duck, catfish and crab.

Protein: Fish is an excellent source of protein due to its quality and quantity. They contain around 20 per cent protein. The biological value of fish protein is 80. Fish is rich in lysine and methionine hence it has supplementary value with cereals and pulses.

SAUSAGES

Sausages are prepared within a casing. Natural casings are made from cleaned animal intestines. But natural casings are expensive and non-uniform. Artificial casings are made from extruded tubes of regenerated collagen, cellulose materials or plastic films. The casings hold the ground meat together and prevent excessive moisture and fat losses during cooking and smoking operations. Large sausages such as bologna may have the casing removed after cooking and smoking and then be sliced and packaged. Such products are known as table-ready meats.

ROLE OF EGG IN COOKERY

There are few ingredients in food preparation that are useful in so many different ways as are eggs. Used alone or in combination with other foods, they may become the major protein dish for a meal.

- Eggs are used as boiled, scrambled or poached for table use.
- Used as a thickening agent —stirred custards and baked custards, soups, puddings. Help in gel formation.
- Emulsifying agent—mayonnaise, ice-cream.
- Leavening agent—cakes, foamy omelette, souffles, meringue. Egg white foam used in certain candies also improves the texture by controlling crystallisation of sugar.
- Binding and coating agent—cutlet, french toast or Bombay toast, banana fritters.
- Interfering substances—ice-creams.

  Beaten egg white act as interfering substance in frozen desserts. Tiny bubbles of air trapped in egg prevent ice crystals from coming together and creating large masses of icy material.
- Clarifying agent—raw eggs can be added to hot broths and coffee. When protein in egg coagulates they trap the loose particles in liquid and clarify it.
- Garnishing agent—hard boiled eggs are often diced and used to garnish dishes.
- Flavouring agent—custards
- Enriching agent—to enrich the nutritive value e.g., Bombay toast.
- Glazing agent—for pastries to give the surface a golden brown colour when cooked.
- Improve colour—custards.

elasticity. The foam can be manipulated and spread without rupturing the cells perhaps because sugar retards the denaturation of egg white.

Table 6.11 summarises the factors affecting volume, stability and time of beating of foams.

Table 6.11: Factors affecting foam formation

Variations	*Volume*	*Stability*	*Time of beating*
Beating time	increases first and then decreases	increases first and then decreases	higher the speed lesser is the time.
Temperature			
low	less	more	more time.
room	more	less	less time.
Thin white	increases	less	less time.
Acid too much	decreases	more	longer time.
	–	reduces	–
Fat	decreases	–	longer time.
Salt	decreases	less	longer time.
Yolk	decreases	–	longer time.
Water	increases	less	lesser time.
Sugar	–	less	longer time.

Omelettes and souffles

Omelettes and souffles are similar in that the main ingredients in both products is egg. Omelettes may be plain or foamy. The plain omelette is made without separating the yolk from white.The whole egg is beaten together with flavouring materials. The foamy omelette is prepared by beating the whites and yolks separately. The whites are beaten until stiff and then folded into the yolk mixture. For preparing foamy omelette the omelette should not be turned on the tawa but should be folded to preserve the air cells that are formed. Foamy omelettes puff up on cooking and they are light and have a better texture due to the incorporation of air. The centre of foamy omelettes would be soft and creamy with small bubbles of air.

For making an omelette, the heat should be kept low so that the mass cooks slowly and can be heated uniformly throughout without toughening the bottom layers. The coagulation of a puffy omelette may be finished in a moderate oven.

Factors affecting omelette quality

- Sometimes, green colour develops in the omelette. This is due to the formation of iron sulphide and when a part of the white separates and drains to the pan underneath the omelette. This can be prevented by beating the yolk with white thoroughly.
- Addition of liquid to egg dilutes the protein and increases the tenderness of omelette. Omelettes made with tomato or orange juice appear to coagulate more rapidly at a somewhat lower temperature. Acidic products like vinegar with water or tomato juice give more tender omelette than water. Addition of acid products increases the beating time. When milk is added to the egg the foam formation is not obtained properly hence the addition of milk affects the quality of omelette.

Milk	1 cup	Eggs	1 - 1½
Sugar	25 g.	Vanilla essence	¼ tsp.

Baked custard: This is made at 350°F. It is done when the tip of a knife inserted halfway between the centre and outside, comes out clean. When a custard is overcooked, some clear liquid separates from the gel structure, that is syneresis occur. In an overcooked custard, the egg proteins that form the mesh-like gel structure apparently shrink and squeeze out some of the liquid that was held in the mesh. Fruits, dry fruits and caramelised sugar can be added to give variety.

Soft custard: Same ingredients are used as in baked custard. The vanilla, because of its volatility is added after the other ingredients are cooked. Custards that are cooked more slowly coagulate more completely at a lower temperature than custards that are cooked rapidly. There is less danger of curdling and both consistency and flavour are better in stirred custards cooked relatively slowly. The total cooking time, in a double boiler should be 12 to 15 minutes, heating more rapidly at first and then more slowly (70°C-75°C water temperature) while stirring thoroughly and rapidly should be done during the entire process. Stirring separates the coagulated particles, resulting in a creamy consistency. The custard will be thicker when it is cold. When the knife comes out coated, the end point has come.

Success in making stirred and baked custards depends on cooking just enough to coagulate the protein of egg. Excessive heat results in over coagulation and syneresis of protein characterised by curdling in stirred custards and in baked custards. Scalding (heating) the milk, used in custards shortens the cooking time and may also improve the product. Baked custards are better when made from milk pre-heated to 90°C than to 50°C. Custards cooked over rapidly boiling water thicken at 87°C and curdle at 90°C thus leaving a narrow margin of safety. However, if the water in the bottom of the double boiler was cold when cooking started and was brought to boil slowly the custard thickens at 52°C and curdles at 87°C. The consistency of a curdled custard can be improved greatly by pouring it into a cool dish and immediately beating with a rotatory beater.

The temperature at which gelation occurs depends on many factors.

Proportion of ingredients: The temperature required is higher than that required to coagulate the egg because the protein of egg is diluted with milk. The higher the proportion of egg to milk the lower the temperature at which the custard sets. But two egg yolks in the place of one egg raise the coagulation temperature. The protein of the egg is not readily denatured by heat when sugar is present. The sweeter the custard the weaker is the gelation at the given temperature.

Rate of cooking: When the cooking is rapid the margin of safety is reduced and curdling can occur easily.

Acid: Acid lowers the setting temperature. The acid supplied by the fruit in custards lowers the gelation temperature and it gets done sooner than one without fruit.

Egg white foams

The foaming of egg white plays an important role in many foods because it makes the products light in texture and contribute to leavening. Egg white foam is a collide consisting of bubbles of air surrounded by albumin that has undergone some denaturation on the liquid air surfaces. This denaturation which is due to the drying and stretching of the albumin during beating makes some of the albumin insoluble thus stiffening and stabilising the foam. During denaturation the protein molecules unfold and their polypeptide chains lie with their long axis parallel to the surface. Over beating incorporates too much air, stretching the albumin so that it becomes thin and less elastic. Elasticity is needed especially in foams that have to be baked so that before the albumin is coagulated by the heat of the oven, the incorporated air can expand without breaking the cell wall.

From the Table it can be concluded that

- Even if the eggs are cooked for a long time there is no green colour if cooked at low temperature.
- When it is put in cold water, after cooking there is no green colour due to the diffusion of hydrogen sulphide gas at the surface of the cooling.
- If eggs are cooked for a long time and at a higher temperature ferrous sulphide, ring formation occurs, even if cooled in cold water immediately.

Eggs which have undergone deterioration during storage lose carbon dioxide, with the result there is increase in the alkalinity. High pH favours the production of hydrogen sulphide. In stale eggs there is more chance for ferrous sulphide ring formation.

To hard cook an egg with the minimum discolouration of the yolk a fresh egg should be cooked in water at simmering temperature followed by prompt cooling.

Silver sulphide

The hydrogen sulphide and elemental sulphur present in boiled eggs oxidise metallic silver to form a layer of silver sulphide. The natural colour of silver sulphide is dirty black. Hence, a silver plate turns black when a boiled egg is placed on it.

Poached eggs

Poached egg is made by breaking and directly putting the egg in boiling water. The egg is left in the hot water until the white is jelly like and uniformly coagulated and the yolk is semi liquid and covered by a thick coating of white. Ideally, a poached egg should be compact with no ragged edges. This needs an egg of top quality. The technique used to put the egg in water also influences the end product.

The addition of vinegar or salt to the cooking water hastens coagulation and hence may improve the shape of poached eggs, particularly having thin whites.

Scrambled eggs

The yolk and white are blended with or without the addition of milk. The mixture is then heated to effect coagulation of proteins. The secret of making scrambled eggs which is moist but not watery, tender and fluffy, is to heat the mix slowly at the bottom of the pan as it coagulates. This prevents the cooked part being over coagulated and allows the uncoagulated part to contact the hot pan. Once the coagulum forms, further heating causes it to shrink and squeeze out more and more liquid and the product becomes dry. Cooking scrambled egg in a double boiler gives better control over the intensity of heat applied to the egg.

Fried eggs

The shape of a fried egg depends on the thickness of its white and on the temperature at which it is cooked. If cooked at too lower temperature i.e., 115°C it will spread excessively and if the temperature is too high 140°C it will be overdone. The ideal temperature to prepare fried egg is around 126-137°C.

Custards

In custard, egg acts as thickening agent. A true custard consists only of eggs, milk, sugar and flavouring compounds. Custards are of two types, the stirred or soft custard which is given a creamy consistency by being stirred while it is cooking and the baked custard which is allowed to coagulate without stirring, thereby producing a gel. Recipe for custard is as follows.

Soft and hard cooked eggs

For a soft cooked egg, the white should be in the consistency of a soft quivery jelly and the yolk a thick liquid. This requires 3-5 minutes of cooking in boiling water. An addition of 2 minutes should be allowed if eggs are at refrigerator temperature. Or should be cooked at 85°C for 4-6 minutes and put in cold water.

Eggs hard cooked in a shell need to be cooked until the white changes to an opaque tender gel and the yolk becomes pale yellow and has a mealy rather than a pasty consistency. Eggs should be cooked at 85°C for 18 minutes or at 100°C for 8-10 minutes and put in cold water. Heat is transmitted from hot-water around the egg to the yolk through the coagulating white by conduction. To get the yolk hot enough to coagulate the surrounding white must be heated somewhat over cooked by the time yolk is fully cooked. The yolk can be hard cooked with minimum damage to the white if the water in which the egg is cooked is not above 85°C. If the temperature of the water is too low, cooking time is excessively long, the white is so tender that it is difficult to remove the shell without tearing the white and the yolk is waxy and has the colour of an uncooked egg.

In both the methods, eggs should be submerged in cold water for 5 minutes. Boiling for 20 minutes produces hard cooked eggs that are firm and exhibit strong egg odour and more off flavours.

Ferrous sulphide formation: The formation of dark greenish discolouration in hard eggs is due to iron and sulphur present in white and yolk. The percentage concentrations of yolk are 11 mg of iron and 0.016 mg sulphur and of white are 0.9 mg iron 0.195 mg of sulphur. The sulphur is present mostly as cystine and methionine amino acids.

On heating hydrogen sulphide is liberated from sulphur containing proteins, which combines with the iron of the yolk and ferrous sulphide is formed. The amount of hydrogen sulphide evolved depends on time and temperature of heating and pH of the eggs.

The effect of temperature and period of cooking on the development of green colour on the surface of the yolk is given in Table 6.9.

Table 6.9: Temperature and period of cooking on ferrous sulphide formation

Temperature (°C)	*Period of cooking (min)*	*Colour of the surface of the yolk*
70	60	No green colour
85	30	No green colour
100	15	Green discolouration
100	15 (cooled in cold water)	No green colour
100	30	Dark green colour
100	30 (cooled in cold water)	Dark green colour

Source: Swaminathan, M., 1992, Food Science and Experimental Foods. The Bangalore Printing and Publishing Co. Ltd., Bangalore.