T H E S I S

LECTURES IN DOMESTIC SCIENCE TO
HIGH SCHOOL STUDENTS.

by

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These students are second year high school students. They have had one year of Domestic Science and one year of Chemistry. They have had four hours of work a week in Domestic Science and they know the five food principles and the classification of foods.

LECTURES IN DOMESTIC SCIENCE TO

HIGH SCHOOL STUDENTS.

Sugars

Starches

Cocoa and Chocolate

Cereals

Proteids in general

Milk and its products

Eggs and Meat

Fats in general

Beverages

Leavening Agents

Yeast

Bread-making.

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Sugars.

Occurrence of sugar

Largely in the vegetable kingdom.

Composition

Non-nitrogenous

Carbon, Hydrogen, Oxygen.

Classification of sugar

Mono-saccharides

De-saccharides

Poly-saccharides

Manufacture

Glucose

Cane sugar

Beet sugar

Maple sugar

Digestion

Absorption

Assimilation

Sugar as a fuel

Economic Value.

Sugars.

Scarcely any other food substance is more universal throughout the vegetable world than sugar. It is not a product of Nature, which like a vegetable, can be easily obtained by some mechanical means, but it is a part of the juices of plants and can be obtained only by expression, evaporation, crystallization, and purification. Sugar is found in the juices of nearly all edible plants but particularly in fruits and sugar-canes. It occurs extensively in subterreanean stems and rhizomes of many plants as beet root, carrot, and parsnips, and in the juices of certain forest trees as the maple sugar and in all edible seeds. Moreover it is found in animals in the blood, flesh and secretions, especially milk. It is both a product of health and of disease.

Such substances as sugars, starches, gums and cellulose are called carbohydrates. Carbohydrates may be defined rather indefinitely by saying they are compounds of carbon, hydrogen and oxygen, the oxygen and hydrogen being in the proportion to form water. They are found chiefly in vegetable tissues and many of them form important foods.

However the most important members of the carbohydrates are the sugars and the starches because of their nutritive value and their effect upon the human system. They are non-nitrogenous, furnishing heat for warming the body, as well as, potential energy for doing its work.

The carbohydrates are classified as monosaccharides, examples of which are levulose, dextrose, and galactose, disaccharides examples of which are cane sugar, lactose, maltose and isomaltose, and the polysaccharides, examples of which are starch, dextrins, cellulose and gums.

For convenience sake the sugars may be divided into the dextrose or glucose and the cane-sugar group. Glucose is largely manufactured from starch, when it is known as starch sugar. Glucose may be divided into its constituent parts, when the granular portion is known commercially as grape sugar and the fluid as syrup-glucose.

Cane sugar is manufactured from the sugar-cane. It is a tall, strong stemmed grass, growing to a height of ten or twelve feet and crowned with long feathery plumes of flowers. It has been cultivated in both China and India for about two thousand years and the art of extracting and boiling down the juice from the plant was practiced as early as the seventh century. There are several different varieties of sugar cane, the quality of each depending upon the soil, climate, and method of culture.

Sugar cane contains on an average eighteen per cent of sugar, more than seventy per cent of water, small quantities of pectin, of albumen, and of mineral matters. Six to eight pounds of the juice of cane-sugar are required to yield one pound of the crystallized article.

The manufacture of cane sugar consists of crushing the sugar cane, and expressing the juice, which is then treated with sulphurous acid for bleaching. It is then neutralized with lime and boiled, this process being used for the purpose of coagulating the proteids. The mixture is then filtered, evaporated down and the uncrystallizable sugar or glucose is separated by means of centrifuge. The raw cane sugar is obtained in a crystallized condition although it is in an impure state. The uncrystallizable sugar is sold as molasses or treacle and is used to make rum and for eating. The chief object in the process of refining is to get rid of these impurities and this is effected by two processes, known as the clay process and the centrifugal process. When sugar is refined by the clay process, a layer of clay is placed over the sugar, the water leaves the clay and passes slowly through the mass of sugar, carrying off the syrup adhering to their crystals and at the same times dissolves and removes very little of the crystallized sugar.

By the centrifugal process the sugar is caused to revolve at great speed in the inside of a drum, which is covered by a fine wire gauze, the syrup being thrown through the meshes in the gauze while the sugar is retained within. Further refining can be done by remelting the sugar, filtering and clarifying it by means of charcoal, after which it is evaporated in a vacuum.

About two-thirds of the sugar upon the market is made from beets instead of sugar-cane. The discovery of the fact that beets contained crystallizable sugar was made by Marggraf, a German chemist in 1747. There were two difficulties to be dealt with, the percentage of sugar in the beet was small and the sugar was separated from the other constituents with difficulty. Later, however a beet was developed that contained a larger per cent of sugar and a smaller per cent of unpleasant impurities. What is considered the best quality of sugar beet contains fifteen per cent of sugar, twelve per cent being necessary for the manufacture of it.

The extracture of beet sugar from the crude beet-root, is a much more complicated process than from sugar cane. The juices are extracted by pressure and by diffusion and then filtered through both lime and charcoal filters. The refining process is identical to that of the cane-sugar.

The syrup from beet-sugar is not nearly so good as the syrup from cane-sugar although there is no evidence for the statement that beet sugar is more injurious to the health. It has been said however, that cane-sugar is less liable to ferment.

Maple sugar is derived from the juice of maple trees. The industry of maple-sugar making is confined to North America and Canada. The tree is tapped in the spring and the sap, which is flowing upward is allowed to escape. The sap is then evaporated and the sugar allowed to crystallize and the redidue is sold as maple syrup. Chemically there is no difference between maple-sugar, beet-sugar and cane-sugar, but on account of etheerial substances, each has a destinctive flavor.

Another compound sugar is lactose. This is the carbohydrate of milk. Although it is in the same class, it has very different properties. Milk contains from three to five per cent lactose.

Cane or beet sugar comes on the market in several different forms. Brown sugar is cane-sugar before all the impurities are removed. Loaf sugar is made by the sugar being caused to run into long moulds. It is afterwards cut into cubes by machinery.

Granulated sugar is made by centrifuge as described. Sugar having large crystals and small proportion of water is considered best for domestic use. Powdered sugar is made by pulverization of granulated sugar.

The process through which a sugar goes during digestion depends upon its chemical form. No matter what sugar is taken, it can be absorbed only as mono-saccharide, that is dextrose or levulose. The sugars are dissolved in the mouth, but practically no other action takes place until it reaches the intestine. However, in the stomach, a small amount of sugar, by means of HCl is changed into dextrose and absorbed. The enzyme invertin of the intestinal juice inverts cane-sugar to dextrose and levulose, the enzyme maltose inverts maltose into dextrose and the enzyme lactose inverts lactose into two molecules of galactose. The simple sugars such as dextrose and levulose do not require inversion but are directly absorbed.

Dextrose and levulose are absorbed by the epithelial cells, transferred by the lymph to the tissues, then by means of the capillaries into the blood stream. When, however, the sugar solution is too concentrated, it is not absorbed, but acts as an irritant to the tissues. After the sugar reaches the blood stream, it is carried by the portal vein to the liver, where it is stored up as glycogen. Glycogen is similar in composition to dextrose. It is a constant constituent of protoplasm and animal tissues generally. When the tissues need sugar the glycogen is changed into destrose, taken to the tissues and oxidized furnishing heat.

In cases where large quantities of sugar are absorbed in the course of a short time, the glycogen-forming power of the liver may be unable to keep pace with the demands made upon it, and some of the sugar will appear in the urine. This result is called alimentary glycosuria.

Carbohydrates are the chief source of muscular energy, hence sugar is a good muscle food. On account of the ease and rapidity of absorption sugar fulfills the function of a muscle food better than any other carbohydrate food. Sugar is fattening. It is probably not only itself transformed into fat but it also spares the body fat.

Sugar is practically a pure carbohydrate food. Therefore its food value must be high. One grain of sugar will yield 4.1 calories of energy. One lump of loaf sugar will yield twenty calories. A pound of butter yields about twice as much energy as a pound of sugar, but butter will cost about five times as much as the sugar and will be more difficult to digest. In general sugar is an economical food.

Starches.

Occurrence of starch,

Vegetable kingdom.

Sources of manufactured starch,

Wheat
Rice and other grains.

Potato.

Classification

Composition

Structure

Properties

Digestion

Absorption

Cookery of starch

Place of starch as food in human diet.

Starches.

Starch is a product which is yielded by the vegetable kingdom only. It is found in all cereals, legumes, roots and tubers, and some fruits. It occurs in small quantities in leaves, barks, stems, and in almost every organ of the higher plants. Starch is the granular portion of the vegetables.

The sources of the starch on the market are wheat, maize, sago, rice, and potatoes. Starch is obtained from wheat and other grains by first grinding them and moistening with water. It is then allowed to stand for several days and fermentation sets in; more water is added and the mixture again allowed to stand, this time about three or four weeks. By this time all the gluten and other nitrogenous matters are dissolved, after which they are separated from the starch by washing. The starch is then dried and ready for market. Rice starch is allowed to stand in very dilute caustic soda solution and the nitrogenous matters are dissolved and the starch left unaltered.

Potato starch is made by the cutting of the potato until a pulp is obtained. The rasped potato is then washed in a sieve, and the water carries down the starch which is dried.

Starch is one of the most important carbohydrates. It is a member of the starch group under the polysaccharides. Other groups under the polysaccharides are the gum group, vegetable mucilage group and the cellulose group.

The size and form of the starch grains differ in different plants, some being small and circular, others large and oyster-shaped, these differences determining the source of the grain.

The shape and size of the granule has an influence on the character of the vegetable in which it is stored. The hardness of rice is due to the fact that the starch granules are small and fit closely together, while in the potato the granules are large and the spaces between them filled with water so that it is a much softer substance.

As starch occurs in nature the granules consist of two principal substances, starch granulose and starch cellulose. Of these only the starch granulose is acted upon by the digestive juices.

Starch is insoluble in cold water, in alcohol and in ether. In hot water the grains swell up and burst yielding a paste, but not going into true solution. This starch paste does not ferment with yeast. The starch granules also swell up when treated with caustic soda or potash. By boiling with water alone or dilute acids, starch is converted into soluble starch; however by further action it is converted into a mixture of maltose and dextrine. This action is hydrolytic, that is a molecule of water enters into combination with a part of the molecule of soluble starch and forms maltose. When starch is heated in the dry state, it is converted into dextrin. This action takes place in the baking of bread.

The digestion of starch begins in the mouth. Here, the ptyalin, the enzyme of the saliva acts upon starches changing them to maltose, through a series of dextrins. This process is continued during the act of swallowing and after it reaches the stomach, until the media becomes .025 per cent hydrochloric acid. For this the time required is twenty or thirty minutes.

While in the stomach the hydrochloric acid may change the maltose already formed into dextrose and this may there be absorbed.

In the intestine the enzyme amylopsin of the pancreatic juice acts upon starch changing it to maltose through a series of destrins. This action is as follows:

Starch

Soluble starch

Erythrodextrin — Maltose

Achrodextrin — Maltose

etc.

The succus intericus of the intestinal juice has a remarkable power in converting maltose into dextrose.

There is no direct absorption of cane-sugar or maltose, so the maltose is changed into dextrose before absorption. This dextrose, as is also the dextrose from cane-sugar, is absorbed by the epithelial cells, transferred by means of the lymph in the tissues, then by the capillaries into the blood stream. By means of the blood it is carried to the liver and is stored up as glycogen for future use, if it is not immediately needed by the tissues.

Raw starch as well as the cellulose of the vegetable is almost impossible to digest. The chief object in the cookery of raw starch is to gelatinize the starch grain, thus softening the grain. When the grain is heated, the starch grain swells up and this swelling causes the envelope of the grains to break down, run together and form a paste. It will be seen from this consideration, the importance of the cookery of starch.

Starch is well cooked when it has cooked over hot water for twenty minutes or direct heat for seven or eight minutes, depending somewhat upon the density of the mixture.

Starch is one of the five food principles. Although a person could not live on starch alone, or foods that are very rich in starch, yet starchy foods have a very important place in our diet.

Cocoa and Chocolate.

Distribution and history of cacao tree.

Cultivation of the tree.

Description of tree and fruit.

Composition of the cacao bean.

Manufacture of chocolate.

Manufacture of cocoa.
Value as a food.

Cookery.

Cocoa and Chocolate.

The cacao tree grows best in a warm, moist climate. It grows in tropical America and surrounding islands, in South America, in the central American republics of Venezuela, Columbia, Guiana, Ecudor, Peru and northern Brazil. The tree has been naturalized in other countries where the soil is moist and rich in humus; the cacao tree blooms throughout the year. It should be sheltered from the direct rays of the sun. The plants are either raised in a nursery or the ground selected for plantation. The seeds lose their vitality very soon so that the making of a new plantation is a difficult task.

The seeds are planted in rows, the shading trees being planted between the rows. Several seeds are planted as they often fail to germinate and then the weaker plants are pulled up. Until the plants are two or three years old they are protected by a shed open at one side.

The knowledge of the cacao tree was first brought from Mexico to Europe in 1519 by Cortez. About the beginning of the seventeenth century, the use of chocolate spread from Spain to Italy and then over Europe, so that by the middle of the century its use was general in England.

The cacao tree grows to the height of thirteen feet and very frequently the trunk attains a considerable diameter at the base. The wood of this tree is light and porous and the bark is cinnamon colored. The upper surface of the leaves is of a bright green color, and the under surface is of a duller color and slightly hairy. The flowers are frequently hairy and occur on the thick branches and also the stem close to the root. The fruit is as a rule formed on the older parts. The seeds are borne in pods, the shape much like a cucumber, but more pointed at the lower extremity and more distinctly grooved. These pods measure from nine to twelve inches in length and about one-half as much in diameter. When young the color of the pods is green, but when ripe become dark yellow or yellowish brown. They have a thick, tough rind. These pods are filled with closely packed beans or seeds embedded in cellular tissue. The beans are about the size of an almond and of a whitish color but they become brown when dried.

It requires four months for the fruit to ripen and they appear and mature throughout the year. There is a chief harvest, which usually occurs in early spring, the time differing somewhat with the country. After gathering the fruits they are left in a heap on the ground for twenty-four hours, then they are gathered in baskets and taken to a place where they may undergo sweating and curing. The acid juice which accompanies the seed is taken off, the seeds placed in a sweating box and allowed to ferment for sometime, care being taken that the temperature does not get too high. The fermentation consists of alcoholic fermentation, the sugars existing in the pulp of seed. Sometimes this fermenting process is effected by throwing the seeds into trenches and covering with clay. This process is called claying.

The seeds are then exposed to the sun for drying and they then have a reddish tint, which signifies a bean of superior quality. The kernel consists of two cotyledons occupying the whole bean; they are of dark reddish brown color having a fatty luster.

The bean or seed is composed of albumin, starch, water, fat, sugar, cellulose, ash, cacao red and theobromine. There is about six or eight per cent water, and about one-half the total weight of the shelled bean is fat. The cacao red is a pigment of the bean that is caused during fermentation. The bean contains a diastatic ferment as well as glucoside body called cacao glucoside which the ferment causes the formation of starch sugar, cacao red, theobromine, and caffeine. Theobromine is the nerve stimulating substance of cocoa. It is found in small quantities. The albumin of the cacao bean is in the form of globulin, thus being a less soluble form of proteid.

Upon the starch, together with the fat and albumin depends the nutritive value of the bean. Cacao starch consista of minute glubular granules and has all the usual properties of all ordinary starch.

The manufacture of chocolate consists in cleaning and sorting the beans, crushing, removing shells and grinding the beans until it forms a paste when warm. The next step is the addition of sugar and spices, extraction of air, division, moulding and then cooling the chocolate.

Cocoa is prepared by roasting, shelling, crushing, and grinding the bean, treatment with water or alkalies, removing the fat and then powdering. The main difference between chocolate and cocoa is the removal of the fat. The amount of fat is reduced to twenty or twenty-five per cent.

Cocoa differs from tea and coffee in that it contains more nutrition. About ten grammes of cocoa is enough to make a cup of cocoa and this amount yields forty calories. However when the beverage is made with milk and sugar the nutritive value is increased. The action of cocoa upon the nervous system is much less than tea or coffee, owing to the small amount of theobromine that it comtains.

Chocolate has more value as a food that cocoa does. Two ounces of chocolate together with one-half pint milk will yield four-hundred calories. Chocolate is a very good fat food, due to the large per cent of fat present.

The objects in the cookery of cocoa and chocolate are to make the raw materials more palatable, more digestible and lastly more nutritious. There are certain extractive principles present, which are soluble only in water which has reached the boiling point. The starch which the cocoa contains cannot be cooked and and be in a digestible condition in a very few minutes but the time required for the cookery of cocoa and chocolate is as long as is ordinarily required for any kind of starch.

Cereals.

Edible portion of plant.

Classification.

General Composition .

Distribution of cereals.

Wheat, rice, corn, oats, barley, rye.

Combination with other foods.

Cookery.

Value as food.

Cereals.

The parts of plants that furnish food are the seeds, the roots and the stem. The plants which furnish their seeds as food belong to two great classes, the cereal or grains and the leguminous plants. Cereals really are grasses but by special cultivation are sources of food. They will grow in almost any climate from the Torrid Zone to the Arctic region. However no country posses soil and climate more appropriate to their growth than does America.

The cereals wheat, rice, corn, oats, barley, rye and millet are the greatest food crops of the world. They are valuable foods for both man and animal.

Among the cereals, wheat ranks first on account of its richness in protein. There are a large number of varieties of wheat due to variation in soil, climate and cultivation. Wheat was cultivated in Egypt about two thousand years before the Christian Era, and the Chinese claim that they cultivated it even seven-hundred years before this date. The cultivation of wheat today is most extensively carried on in the Western America, Russia, India, France and other European countries.

The general composition of cereals is water ten or twelve per cent, proteid ten or twelve per cent, carbohydrate sixty-five to seventy-five per cent, fat one-half to eight per cent, and mineral matter two per cent.

When a grain of wheat is cut and placed under a microscope it is found to consist of a germ or embryo which is rich in proteid and fat, the kernel or endosperm which contains the nutrition for the embryo. This is characterized by its richness in starch.

The bran or outer covering is composed chiefly of mineral matter and cellulose. Its use is to protect the grain. This bran or outer covering really consists of three layers, an outside layer consisting of mineral matter and cellulose, a middle layer consisting chiefly of pigment, which gives the covering its color and an inner layer which consists of a single row of quite large cells which contain a proteid called aleurone. Sometimes this layer is called the cerealine layer. These outer layers are not of value to man as food.

Wheats are classified as hard and soft, red and white, and spring and winter wheats. They are also subdivided as bearded and beardless varieties. The hardness and softness of wheat depends upon the amount of gluten it contains and also its maturity. Hard wheat grows in climates with long summers where the grain has time to mature well. It is said to be more nutritious because it contains more starch and proteid. The red and white wheat depend upon the color of the grain. Any variety of wheat may be spring or winter wheat, it depending on the time of the year the grain is planted.

The most important use of wheat is the manufacture of flour. Gluten, the proteid of flour renders dough tenaceous, hence wheat flour is a good material for breadmaking. Besides this it is used largely in the preparation of macaroni. The most important breakfast foods made from wheat are cracked wheat, rolled wheat, germ wheat, and various prepared breakfast foods. The latter are palatable and digestible, but very little real nutriment is received in proportion to the amount paid in excess of the price of wheat.

Indian corn or maize as it is more commonly called, is a native of America. The plant is tall and slender and grows best in the Temperate Zone. The ears vary greatly in size and the size and color of the grain. In a general way corn has about the same structure as does wheat. Although corn contains about as much starch and about five times as much fat, it is inferior to wheat, the cause being due to the lack of gluten and hence it cannot be used in making bread. The products of corn are cornstarch and cornmeal which is one of the most valuable cereals. There are a large number of prepared breakfast foods made from corn.

Barley has been highly valued as a food since an early date. It has a wider range of habitation than most cereals because it can stand more heat and more cold. In the warm climates two crops a year are harvested. Barley contains more starch and less gluten than wheat, hence it is inferior as it cannot be used in breadmaking. Barley is used as a basis of all alcoholic drinks. A barley meal is used very extensively in England and Scotland.

Rice had its origin in India and China. It has the same general structure as do the other cereals. There are a comparative large number of species of rice. It is rich in starch but inferior to wheat, barley, and corn because it contains a small amount of proteid. Rice flour is used considerable. It is largely used for the prepared breakfast foods.

Oats stand high nutritively in the list of cereal foods, but cannot be used in breadmaking on account of its lack of gluten. It is used extensively as a breakfast food prepared by crushing and rolling.

On account of the large amount of carbohydrate in cereals, they should not be eaten alone but in combination with other foods rich in fat and proteid. They can be well prepared by mixing with milk and egg in puddings.

The cookery of cereals is the same as other starchy foods and the length of time varies with the fineness of their division and the variety of the grain. The time required for the cookery of whole oats is twenty-four hours and for cracked oats eight hours. The time required for the cookery of whole wheat is twenty-four hours, for cracked wheat eight hours, for cream of wheat forty-five minutes and for flour twenty minutes.

As a group, cereals are digestible, extremely well absorbed, and this together with their compactness of nutriment, give them a high rank among foods.

Proteids in General.

Sources of proteids.

Composition.

Classification.

Digestion.

Cookery.

Value as a food.

Proteids in General.

Proteids are the most important substances present in animal and vegetable organism, in fact none of the phenomena of life occur without their presence. Proteids and non-proteids are the nitrogenous constituents of food. They are very complex and are composed of Carbon, Hydrogen, Oxygen, Nitrogen and sometimes Sulphur. Different members of the group present different physical properties and to some extent different chemical properties. The nitrogenous foods are divided into proteids and non-proteids. The proteid foods are divided into simple and compound proteids. Simple proteids are constituents of animal and vegetable organism and especially in the animal body where they are constituents of the muscles, glands, and blood serum. The simple proteids are divided into the native and derived.

The native proteids are those which occur formed in the ordinary sense in organic fluids and tissues, which can be isolated from them without destroying their original properties. Examples of native proteids are albumins and globulins. Albumins are soluble in water and dilute saline solutions; also precipitated by saturating their solutions with ammonium sulphate. Examples of albumins are serum-albumin of the blood and lacta-albumin of milk.

The globulins are insoluble in water, soluble in saline solution, and coagulated by heat. Examples are fibrinogen of the muscle and serum globulin of the blood.

Derived proteids are formed from the native proteids by action of acids, weak alkalies, enzymes, and by heat. The derived proteids are the albuminates, proteosis and peptones, and coagulated proteids. The albuminates do not coagulate with heat. The two albuminates are acid albuminate and alkali albuminate.

The proteosis and peptones are formed from other proteids in the digestive tract by the action of proteolytic enzymes. They are also formed by the hydrolytic decomposition of proteids, by acids and alkalies and by putrefaction. Peptones are the final products of digestion that can be called proteids. Both proteosis and peptones are not coagulated upon boiling, and proteosis are precipitated by adding sodium chloride solution while peptones are not. An example is albuminoses from albumin.

The coagulated proteids include proteids which have been coagulated by heat, by action of alcohol, or by enzyme action. They are insoluble in water, salt solutions and dilute acids or alkalies. An example is fibrin of fibrinogen.

The compound proteids are compounds of albuminose substance with other materials which are also of a complex nature. The compound proteids are the respiratory pigments, gluco-proteids, nucleins, nucleo-proteids and nucleo-albumin.

The respiratory pigment is the coloring matter of the blood. An example is haemogloblin in the blood which combines with oxygen of the blood and is a constant constituent of the red corpuscle.

Gluco-proteids are compounds of proteid and carbohydrates. On decomposition they yield a carbohydrate-like substance.

There are two kinds of nucleins, the true nucleins and the psendo-nucleins. The true nucleins are compounds of proteid and nucleic acid and when boiled with dilute acids decompose into proteids, phosphoric acid and xanthine substances.

Psendo-nucleins are compounds of proteid and true or psendo nucleins. Examples are casein of caseinogen, legunin of peas and beans.

The lecith albumins are compounds of proteid and lecithins. Examples are found in the kidneys, lungs, spleen and liver.

In the digestion of proteids there is no action upon the proteids in the mouth. The food then passes into the stomach and is mixed with the gastric juice, the digestive juice containing Hcl, pepsin and rennin. Pepsin acts better in an acid media and it is found that the best proteolytic digestion results from 1 to 2% Hcl.

The action of Hcl and pepsin upon proteids in the stomach is as follows: (illustrated)

Proteid

Acid Albumin

proteo albuminose hetero-albuminose

deuteroalbuminose

Ampho peptone

The food then passes into the intestines where the proteids are acted upon by the trypsin of the pancreatic juice as follows:

Proteid

Alkali albumin

Deutero-albumin

Ampho-peptone

anti-peptone hemi-peptone

leucine tyrosin amido acids

It is now generally agreed that the absorption of proteids takes place in the stomach and intestines during any stage of digestion. The proteids are absorbed by the epithetial cells of the intestines, taken by the lymph to the tissues then by means of capillaries they enter the blood stream and are carried to the liver by the portal vein. In the absence of carbohydrate, some of the proteid may be changed into glycogen. However if is not needed for this purpose it goes to the tissues. There are two theories of proteid anabolism, the cell proteid theory and the circulating proteid theory. The former is that all proteids must first be made into cell proteids. The latter that all cell proteid must be changed to circulating proteid which furnishes energy.

The effect of cooking upon proteids is coagulation. It is a mistake to think that boiling temperature is necessary for coagulation but it is not because all proteids, both animal and vegetable, coagulate at the temperature 170° F. If the temperature is raised above this point the proteid shrinks, hardens, becomes tough and indigestible.

Proteids are very valuable as food because they give energy and heat to the body. Their chief value, however, is to build the body tissue.

Milk and its Products.

Milk,

Sources of milk.

Composition.

Effect of heat upon milk.

Souring of milk.

Digestibility of milk.

Coagulation and curding of milk.

Value of milk as food.

Cream,

Formation

Composition

Value as a food.

Butter,

Making

Composition

Use as a food.

Cheese,

Manufacture.

Composition.

Digestibility.

Nutritive Value.

Milk and its Products.

Milk.

The milk of several animals such as the cow, goats, mares, and camels are used as foods, but as a rule, when milk is spoken of cows milk is meant, because it is most commonly employed. These varieties differ in some respects as to odor, taste, and composition, but all contain the elements necessary for life in a fairly good proportion.

Cows milk is opaquely white or of a buff-tinted white, has a sweet taste and an agreeable odor. The composition of cows milk is eighty-seven to eighty-eight per cent water, two to three per cent proteids, four to five per cent sugar, three and one-half to four and one-half per cent fat, and seven-tenths per cent mineral matter.

The important proteid of milk is casein which is kept in or partly in solution by phosphate of lime. This solution is opalescent and causes the characteristic color of milk. Another proteid contained to some extent is lacta-albumin which is quite different from casein and which is coagulated by heat.

The carbohydrate of milk is milk sugar or lactose. It differs from cane sugar in not being so sweet.

Fat is contained in milk in the form of an emulsion. When milk is allowed to stand these globules rise to the surface and form cream.

The principal mineral constituents of milk are phosphate of potash and phosphate of lime, both of which are necessary to build tissue, the former building muscle and the latter bone. Citric acid is also a constituent of milk being combined with lime forming calcium citrate.

When milk is boiled there is a "skin" that forms over the surface which is caused by the coagulation of the lactaalbumin of the milk. By boiling milk, it is sterilized, and when milk is to be kept for some time, this is a good method of treatment. Sterilization kills the micro-organisma of milk, which are of two classes: those that produce souring and pathogenic bacteria, which are the disease germs.

When milk is acted upon by the ferment rennin, it is coagulated. The curding of milk is caused by the lactic acid present, which separates the casein from the lime salts, and throws it down as a precipitate. The lactic acid that causes this action is produced by a certain bacteria always present in milk, and which acts upon the milk sugar.

When milk is taken into the stomach, it does not remain a fluid as outside, but by the action of rennin it is coagulated into a solid mass, as a rule it shrinks into a tough leathery mass and resists digestion. The density of this clot depends upon the degree of acidity of the gastric juice and upon the amount of lime salts and casein that the milk contains. If the milk is diluted or if it is taken in small quantity, the size and density of the clot is reduced. Boiled milk is difficult to digest if not more than raw milk.

Milk is more easily absorbed by a child than an adult. An adult, on exclusive milk diet, only about ninety per cent of potential energy it actually contains ever reaches the blood. One reason why milk is a good food for the sick, is because it is absorbed in the intestine with but little expenditure of energy.

Milk contains all the five food principles, but not in the proper proportion for adults, as it contains too little carbohydrate and is too rich in proteid and fat, for a perfect food. It is also too bulky. It requires a large quantity to obtain the necessary amount of food principles.

Milk is not completely absorbed, and it does not leave enough residue to stimulate peristalsis. Although milk is the cheapest source of animal proteid, yet it is too expensive, to be the chief source for the proteid which the body requires.

Cream.

The chief constituent of cream is fat. However, it also contains proteid, sugar and water. It differs from milk, in that it contains much less amount of water. Cream can be obtained by allowing the milk to stand. The sixty-five per cent cream is the best, although the cream containing forty per cent fat is that ordinarily used, while the cream obtained by skimming contains about twenty per cent fat. Cream is a fuel food. It is a good method of obtaining fat and is easily digested, hence it is a good food for the sick. However, it is not an economical source of fat and it must necessarily be regarded as a luxury.

Butter.

Butter is made by the churning of cream. The fat globules unite in a mass and the fluid containing the sugar and the most of the casein forms what is generally called butter-milk.

Butter contains on an average about eighty-two per cent of fat, twelve to fifteen per cent water and two per cent casein and milk sugar. Butter is very rich in fatty acids of which butyric is the principal one. Because butter is easily digested makes it a good source of fat in case of sickness. The cooking of butter makes it less digestible because of the formation of fatty acids.

Cheese.

The chief constituents of cheese are fat and casein. The nature of the cheese depends upon the kind of milk used.

It may be made by the action of rennin on milk causing coagulation and the cheese will consist largely of fat. It may also be allowed to sour by the addition of an acid. In this case it consists largely of casein. After this process, it is treated with pressure, when high pressure is used the result is a hard cheese and when low pressure is used a soft cheese results. The next step is the ripening which is brought about by certain bacteria which causes its characteristic flavor.

The composition of cheese depends upon the kind. In general it contains water, fat, ash and nitrogenous matter.

Cheese is difficult of digestion by the delicate stomach. In all cases it should be grated or pulverized before eaten. Thus a hard cheese is more easily digested because it can be more thoroughly masticated. However, the difficulty of digestion of cheese occurs only in the stomach, when in the intestine it is readily absorbed.

A high temperature is not necessary for the cookery of cheese. A high temperature renders it less digestible. When cheese is cooked it becomes tough, thus it is better to have cheese in combination with other foods such as macaroni or milk and eggs as in the case of a souffle rather than alone.

Cheese has a very high nutritive value. It contains twice as much nutriment as the same weight of meat. Hence cheese is a cheap substitute for meat.

Eggs and Meat.

Eggs,

- Kinds of eggs used.
- Average weight
- Composition of whole egg.
- Composition of edible portion.
- White
- Yolk
- Shell
- Preservation of eggs.
- Digestibility
- Absorption
- Nutritive value

Meat,

- Kinds
- Physical structure
- Composition
- Cookery
- Digestibility
- Absorption
- Nutritive and economic value.

Eggs and Meat.

The animal foods are various parts of animals, eggs, and milk and its products.

An egg is an undeveloped chick, therefore it must contain all that is required for the construction of the body tissues. Various kinds of eggs are eaten, those of the reptiles such as the turtles, as well as those of birds. The eggs of birds that are eaten are the hens egg, ostrich, turkey, guinea, goose and duck. The one chiefly employed as an article of food is the hen's egg. The average weight of an egg is two ounces, the shell composing one-tenth of this weight.

The composition of the entire egg is, shell eleven and two-tenths per cent, water sixty-five and five-tenths, nitrogenous matter thirteen and one-tenth, fatty matter nine and three-tenths, and ash nine-tenths.

The composition of the edible portion is,water seventy-three and seven-tenths per cent, proteid fourteen and eight-tenths per cent, fat ten and five-tenths per cent,and ash one-tenth per cent.

The white of the egg contains more water than the yolk. It consists of a solution of proteids enclosed within very thin-walled cells. Although the white of egg is called albumin, it is not a single proteid, but a mixture of them. When the white of egg is beaten the walls of the cells are broken allowing the proteid to escape thereby increasing its digestibility.

The yolk differs from the white in composition. It contains the nutriment for the chick, thus a less per cent of water and a larger proportion of fat. The fat is held in suspension by the albuminous matter of the yolk. The yolk is surrounded by a membrane, which keeps the fluid matter together. The yolk is lighter than the white and floats but is held in position between the two extremities by two processes of albumin, each attached to either end of the egg.

The chief constituent of the shell of the egg is carbonate of lime. As the chick developes the shell becomes thinner thus showing that it furnishes the mineral matter for the bones.

When the shell of the egg is examines there is found a large number of pores through which evaporation proceeds. Thus eggs are a perishable food and when the demand is less than the supply they must in some way be preserved. One method of preserving them is by cold storage. This depends upon the temperature checking the growth of micro-organisms. Another method of preservation is by protection from the air. They can be coated by immerseing the egg in lime water and allowing them to dry in air. A uniform coating of calcium hydrate is left and by absorbing the carbon-dioxide from the air, it is changed to carbonate which sets and closes the pores. However, better results are obtained by means of water-glass. The fresh eggs are allowed to stand in a warm solution of sodium silicate for about thirty minutes and then allowed to dry in air. The silicate reacts with Calcium Carbonate of the shell and forms sodium carbonate and calcium silicate, the letter forming the coating over the shell. Other methods, such as covering with salt solution are used but these methods fail to preserve eggs for a long time.

The digestibility of eggs depend upon the form in which they are taken. If an egg is raw or softly cooked, it is very easily digested but if it is cooked hard, until it becomes tough and leathery, it is very hard to digest.

The absorption of eggs in the intestine is quite complete and there is little residue.

The proteid and fat of the egg give it, its high nutritive value. One egg contains about seventy Calories of energy. Eggs are not a complete food because they lack carbohydrate.

Meat.

The meats ordinarily consumed are beef, mutton, veal, lamb, pork, and venison. Beef is of firm texture and possesses strengthening qualities. Mutton is more easily digested than beef. Although veal and lamb are tender yet they are very resistant to digestive juices. Pork is harder to digest than any other kind of meat, on account of its richness in fat.

When meat is examined it will be found to consist of bundles of fibers, which in turn are made up of bundles of fibers, which are held together by connective tissue. Connective tissue is chiefly composed of collogen, a substance which yields gelatin upon boiling. The older the animal, the firmer is the connective tissue. Small globules of fat are embedded in the connective tissue between the fibers.

The small muscle fibers contain water, which holds the proteids, salts and extractives in solution. In young animals the fibers contain more water hence are of less nutritive value.

The three important proteids contained in meat are myosin, muscle-albumin and haemogloblin. Myosin is the most important one and is the one that causes rigor-mortis, after death, by coagulation. The amount of haemogloblin present in meat differs with the kind of meat.

Phosphoric acid and potash are the mineral substances in meat. The next important constituent of meat is the extractives.

The characteristic flavor of meats is due to the amount and kind of extracts present. When meat is boiled a long time it becomes flavorless because all the extracts are removed.

The composition of meat may be summed up as, water seventy-five to seventy-seven per cent, muscle fiber thirteen to eighteen per cent, connective tissue two to five per cent, fat one-half to three per cent, ash eight-tenths to one and eight-tenths, and extractives one-half per cent.

The structure of meat is changed when it is cooked, the connective tissues are converted into gelatin, thus loosening the fibers, the particles of fat are removed and the amount of water is diminished.

In digestion the meat fibers swell up and are softened; they are grayish yellow in color, finally falling apart and appearing pulpy. The more closely the fibers are attached to one another they will separate less readily, also the more fat contained the less readily the gastric juice can soften them. It has been found that raw meats are more digestible than the cooked, but cooking makes them more palatable.

Nearly all of the meat is absorbed and there is very little residue in the intestines, about five per cent.

The large amount of proteid present in the meat causes its high nutritive value. It is considered a quick fuel as it can be broken down quite rapidly with liberation of heat. It is a good building material for the body.

The economic value of meat depends to a great extent upon the cut used. A cheap cut, while not so well flavored or so tender, yet if properly cooked contains as much nutriment as a more expensive cut. Often from the economical point of view, meat is an expensive food, but because the extractives stimulate, the digestion of other foods it becomes one of the most valuable food substances and it must occur to some extent in all dietaries.

Fats in General.

Sources of fat.

Properties

Effect of heat upon fat.

Classification

Composition.

Digestion of fat.

Use of fat as food.

Fats in General.

Fats consist chiefly of compounds, of glycerol, which is a triacid alcohol, with certain acids of the acetic acid series, fatty acids and some other acids. They are ethereal salts of glycerol. Fats are complex because they are mixtures of a number of substances. All animal fats consist chiefly of tri-stearin, tri-palmatin, and tri-olein.

Fats are widely distributed in nature both in animal and vegetable life. In the vegetable life it occurs principally in seeds and fruits. In animal life, it occurs in the connective tissue of the muscles, in the abdominal cavity, and in the connective tissue of the skin. About one-fifth of the entire body weight is fat.

Fats contain the three elements carbon, hydrogen and oxygen as do starches and sugars, but differ from them because they are not in the proportion to form water, when the molecule is split up.

Fats are colorless and when pure, odorless and tasteless; they are lighter than water and insoluble in it. They dissolve in alcohol, chloroform, benzene and ether which is their best solvent. All fats are non-volatile, hence they make a grease spot. Liquids neutralize them, giving an emulsion. When fat is shaken with water it produces a temporary emulsion. The presence of a small quantity of soap or an alkali and fatty acid produces a permanent emulsion.

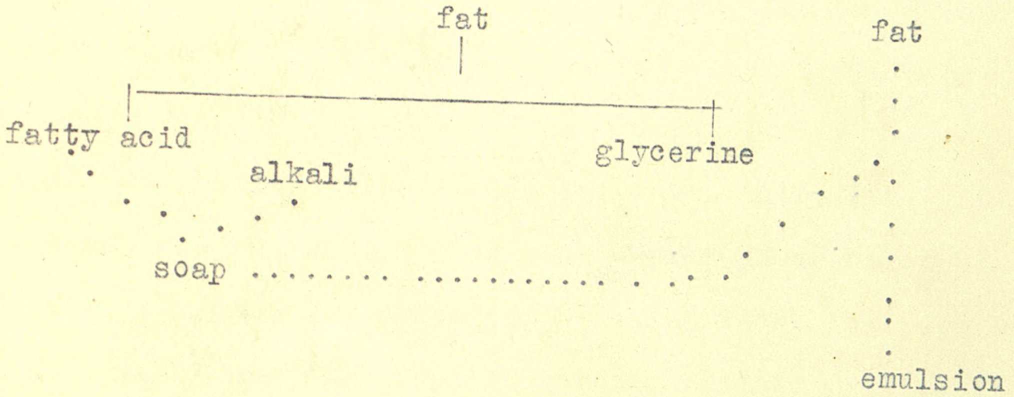
When fats are strongly heated they decompose, forming a large variety of products, among which is acrolein, a substance which gives burning fats their strong odor and irritating effects.

When fats and oils are exposed to the air and light, they become an acid. Part of the fats are split up into acids and glycerine and there is oxidation of the free acids with the deduction of volatile substances, having an unpleasant odor. These free acids give rancid fat its acid reaction.

The uses of fats to the body are to furnish energy for the development of heat, to serve as a covering and be a protection to the bones, to give rotundity to the form and to serve for the storage of energy.

In digestion, fat is not acted upon, until it reaches the intestine. In the stomach the fat globules are set free by the dissolving of the substances around it. When it reaches the small intestine the steapsin, which is the fat-splitting enzyme of the pancreatic juice together with the bile cause saponification and emulsion of fat.

The action is as follows: (illustrating)



There are three theories of fat absorption:

I. All the fat is changed into fatty-acid and glycerine and absorbed as such and is changed back as it passes through.

II. The fat is changed into fatty acids and glycerine, the fatty acid then uniting with the alkali caused by the bile forming a soap and is absorbed as such.

III. The fat is changed into fatty acid and glycerine; fatty acid then acts with alkali forming soap, the soap then unites with the rest of the fat forming an emulsion and is absorbed as such.

Bacteria in the intestines act upon fats and decompose them into fatty acids. Some of these acids are absorbed and some are not. The first action of the bacteria on fats consists of the setting free of the corresponding fatty acids and these break down in mixtures of fatty acids lower in the series.

It has been said that fats aid digestion by preventing the starchy foods to form lumpy masses in the mouth and stomach while others say that it henders starch digestion by making a covering of fat over the starch grain.

Animal fat is more easily digested than vegetable fat. Animal fats have the same nutritive value that the vegetable fats have. The digestibility of fats depends upon the length of time of cooking. When heated to a very high temperature, it decomposes into fatty acids, which are not easily digestible. In general fats have a beneficial effect upon nutrition. Fats yield two and one-fourth times as much energy as do carbohydrates.

In cold climates the number of Calories which the diet is capable of yielding should be considerably raised. To avoid overloading the stomach, fat should be used as the principal source of the extra heat required. Carbohydrates would serve as well, as dar as the cells of the body are concerned, but besides being hard to obtain, it would require more than twice as much to obtain the same amount of heat. In the winter season more fat should be eaten because the body needs more heat.

Although fat yields energy and has almost complete absorption, it is quite an expensive food. Compared with carbohydrates fat is an expensive food.

Beverages.

Tea,

- History of tea
- Cultivation
- Manufacture
- Kinds
- Composition
- Method of preparation
- Use in diet,
  - Good effects
  - Bad effects

Coffee,

- History of coffee
- Cultivation of plant
  - Description of the fruit
- Manufacture of coffee
- Kinds
- Composition
- Methods of preparation
- Use in diet,
  - Good effects
  - Ill effects
- Nutritive value
- Coffee compared with tea.

Beverages.

Tea.

In sixteen-hundred and ten the Dutch East India Company first introduced tea into Europe. It was at that time very expensive, so that the progress was slow. Until sixteen-hundred and sixty-two nearly all the tea consumed was obtained from China but at the present time only about twelve per cent of the tea comes from China. Most of the teas come from Japan, India and Ceylon. Tea has now become a general article of domestic consumption in every household of the country.

The tea plants are grown in beds that are formed conveniently for their irrigation and the plucking of the leaves.

The manufacture of tea consists of the plucking of the young leaves of the plant and placing them in the sun; after withering they are rolled and twisted. The leaves are then pressed into small masses and moistened and allowed to ferment, after which they are subjected to a temperature that evaporates the moisture. Finally the leaves are sifted and assorted into different qualities of tea.

The estimation of the value of the tea depends upon its flavor which is largely influenced by the fermentation process, which requires great care.

The two chief varieties of the tea-plant are the Thea-bobea and the Thea-viridis, although there are a large number of other varieties. It was formerly supposed that black tea resulted from the Thea-bobea and green tea from the Thea-virdis, but it was found that the green tea and black tea could both be obtained from each variety of plant, the difference in the nature of the article depending upon the method of preparation.

Green tea is prepared from the young leaves, which within a short time after gathering, are roasted in pans over a brisk fire. After roasting four or five minutes, they are rolled by hand, thrown into drying pans where they are kept in rapid motion about one and one-half hours. Prussian blue, gypsum, and sometimes indigo and copper are used on the teas, which are sent to the foreign market, the purpose being to give them an attractive bloom.

In the manufacture of black tea, the leaves are allowed to lay in heaps for ten or twelve hours after gathering and during this time they undergo fermentation. They are then tossed about until they become soft, and are rolled and heated alternately three or four times, after which they are dried slowly over charcoal fires.

The most important constituents of tea are astringent matter of the nature of tannic acid, to which its bitter taste is due, a volatile oil, and a crystallizable body, having an alkaline nature and rich in nitrogen called theine.

The flavor of the beverage depends upon the method of preparation. Tea is made by infusion. This is done by pouring boiling water on the leaves and allowing it to stand three or four minutes if it is to have a delicate flavor. The water used should be neither too soft nor too hard. The water used should be used immediately after it comes to the boiling point, as water by boiling loses its gases and has a flat taste.

Tea is not to be looked upon as an article of nutrition. When tea is taken in moderate quantity it is a mild stimulant upon the nervous system and increases the action of the vital organs. It has a refreshing sensation and relieves bodily fatigue.

Tea has ill effects when taken in large quantities. It produces nervousness and when taken in large quantities with meals, it precipitates the digestive ferments, retards the activity of digestion and may finally cause gastric irritation.

Coffee.

In the year sixteen hundred and fifty-two coffee was introduced in America by a retired Smyrna merchant. It consists of berries or seeds of the Coffaea Arabira, which was originally produced in Arabia, but is now cultivated in many tropical countries.

There are three harvests annually. The beans consist of two halves placed face to face and enclosed in a husk. The fruit resembles a cherry, the bean corresponding to the stone of the cherry. The pulp is softened by fermentation and removed leaving the beans, still enclosed in their husks, to dry in the air. The husk is then separated from the more delicate skin or covering and the beans are assorted according to the size.

The beans must first be roasted before they can be used to make a beverage. The physical change that is undergone during roasting, is that the beans are made brittle so that they can be ground. The chemical change is more marked, the bean losing about fifteen to twenty per cent of its weight there being equal parts of moisture and organic matter. It loses fat and caffeine. The important substance produced during the process of roasting is an oil called caffeal, which gives coffee its fragrance.

The chief kinds of coffee are the Mocha, Ceylon plantation, Costa Rica, Java and Brazil, all differing in size, and color.

The chief constituents of the coffee bean are water, fat, crude fiber, ash caffeine, albuminoids and other nitrogenous matter and a small per cent of sugar, gum, and dextrine. The effects of coffee are caused by the ingredients caffeine, caffeotannic and caffeic acids, and caffeal a volatile oil.

The methods used in the preparation of coffee as a beverage are filtration, infusion and decoction. In this process the air is excluded as much as possible and boiling water is caused percolate slowly through finely ground coffee. In this process only ten to fifteen per cent of the coffee is obtained.

A common method of preparation of coffee is by infusion. Boiling water is poured over finely ground coffee and removed from the fire and allowed to stand about ten minutes at a temperature of one hundred and eighty degrees. In this method from twenty-five to thirty-five per cent of the coffee used goes into solution.

Decoction is used in the East. The coffee is ground to a powder, placed in cold water, which is heated until it boils.

For good coffee, the bean should be freshly roasted. As in the case of teas, soft water extracts more coffee from the bean than hard.

When coffee is taken in moderate amounts it has good effects. It removes sensation of fatigue in the muscles, strengthens the heart action, and stimulates nerve centers. It is also a mild stimulant to gastric digestion.

When strong coffee is taken after heavy meals, it stimulates digestion if it is good. However by dyspeptics it should be avoided. When coffee drinking becomes a habit it usually results in ill effects. These are nervousness, heart-burn, dyspepsia and constipation.

The nutritive value of coffee as well as tea is too slight to be considered. However, when they are used with sugar and cream they have some food value.

In United States coffee is believed to be more digestible than tea while in Europe tea is considered the more valuable. In equal weights tea contains about twice as much theine as coffee does caffeine, but in this country about fifty per cent more of coffee is used to the same amount of water. When taken in large quantities it is said that tea irritates the mucous membrane more than coffee, but coffee has a more decided effect upon the action of the heart.

Leavening Agents.

Definition of leavening agent

Kinds,

Air

Soda

Properties

appearance

taste

action with

cold water

hot water

acids

Use in Cooking.

Cream of tartar

Source

properties

Baking powder

Kinds in use with formulaes.

Uses of leavening agents.

Leavening Agents.

A leavening agent is a gas or one or more substances that produce a gas and make dough or batter to become light. The kinds of leavening agents are air, soda, cream of tartar, baking powder, and yeast.

Yeast is the oldest leavening agent. In olden times the people let their bread stand in the open air until enough yeast from the air caused the mixture to rise. Yeast was then manufactured but its slowness caused people to look for something else, therefore the use of air and chemicals has been adopted.

Air is a mixture of the gases nitrogen and oxygen, which carry various amounts of other substances, and suspended particles so that no definite composition can be given. Air is incorporated into the mixture by heating the batter, or by incorporating the air in beaten eggs and adding these to the dough.

Soda or sodium bicarbonate is a by-product of the Solvay process of the manufacture of sodium carbonate. It may also be prepared by treating crystallized sodium carbonate with carbon dioxide gas. Soda is a white powder having a sharp taste. It effervesces with cold water, is soluble in hot water and when heated or mixed with an acid it gives up carbon dioxide. When soda is used with sour milk it reacts with the lactic acid present giving off carbon dioxide and forming sodium lactate. When used with lemon juice sodium citrate is formed and when used with molasses sodium citrate is formed.

Cream of tartar is formed in wine casks by the fermentation of grape juice. The crude cream of tartar is formed and collects on the sides and bottom of the casks. In this state it is called argol. These argol are then purified and cream of tartar as we use it for baking purposes is formed. It is a fine, white powder having an acid taste.

There are three principal kinds of baking powders, the tartaric powders, in which the acid constituent is tartaric acid, the phosphate powders, in which the acid constituent is phosphoric acid, and the alum powders in which the acid constituent is furnished by sulphuric acid contained in some form of alum salt.

In the tartaric baking powders the tartaric acid is usually furnished by cream of tartar. Sometimes the free tartaric acid is used but not very frequently. (Illustrate by equation):

$$KHC_4H_4O_6 + NaHCO_3 = KNaC_4H_4O_6 + CO_2 + H_2O$$

potassium bitartrate, sodium bicarbonate, potassium sodium tartrate.

The products of this reaction are carbon-dioxide and the potassium and sodium tartrate which is the residue. This salt is usually called Rochelle salt.

In the use of the tartaric acid for the manufacture of baking powder there is less residue. (Illustrated):

$$H_2C_4H_4O_6 + 2\ NaHCO_3 = Na_2C_4H_4O_6 + 2H_2O + 2\ CO_2$$

Tartaric acid, Bicarbonate of sodium, Tartrate of sodium.

The combination is seldom used by manufacturers, the reason being that the free tartaric acid is more expensive than the bitartrate. Also it is more soluble, and this might be an objection, as it is an object in baking-powder that the gas should be liberated quite slowly.

In the phosphate baking powders the salt used to supply the phosphoric acid is phosphate of lime. (Illustrated):

$$CaH_4(PO_4)_2 + 2\,NaHCO_3 = CaHPO_4 + Na_2HPO_4 + 2\,CO_2 + 2\,H_2O.$$

mono-calcic phosphate	bicarbonate of soda	calcic phosphate	disodic phosphate

In cases of defective nutrition phosphates are given.

In the alum baking powders the sulphuric acid is furnished by alum salts. The alum is precipitated as hydrate, the sulphuric acid of the salt goes to the bicarbonate to displace the carbon-dioxide. Burnt alum or sulphate of aluminium and ammonia is generally used. (Illustrated):

$$(NH4)_2\,Al_2(SO_4)_4 + 6NaHCO_3 = Al_2(OH)6 + 3\,Na2SO4 + (NH_4)_2SO4 + 6CO_2$$

Burnt alum	Bicarbonate of sodium	hydrate of aluminium	sulphate of soda	sulphate of ammonia

The hygienic quality of the alum baking powder is questionable. The residue, sodium sulphate, better known as Glauber's salt would be a dangerous food for those persons having a very weak digestive apparatus. The aluminium hydrate, another residue enters into insoluble combination with such foods as the albuminoids and phosphates, have an irritating effect upon the mucous membrane of the stomach and have a disastrous effect upon the nervous system.

Next of importance after the hygienic quality of baking powder comes the leavening quality, which is effected by the evolution of carbon-dioxide within the dough, in the proper quantity and at the proper time. The liberation of carbon-dioxide should not be too rapid or it will escape before the mixture is placed in the oven.

Baking powder should be kept in a dry place as it will absorb moisture from the atmosphere, thus losing its power of producing carbon-dioxide.

The reason for the use of leavening agents are to improve the appearance, improve the taste, and to render the mixture more digestible because of porosity.

Yeast.

Life history of the plant.

Description of the plant.

Growth.

Classification

Conditions effecting growth.

Manufacture.

Purification

Strength

Keeping qualities.

Yeast.

Yeast is a plant of exceedingly simple structure, in fact it is one of the simplest plants known. One of the main differences between the plant and animal life is that the plants are able to get their nourishment from inorganic compounds, as the plant derives its carbon from the carbon-dioxide and its nitrogen from ammonia. On the other hand, animals can make no use of carbon or nitrogen for the purpose of building up the tissue unless it comes from organic compounds. Yeast cannot assimilate carbon from inorganic sources but is able to derive its nitrogenous nutriment from inorganic bodies, hence it is placed in the vegetable kingdom.

The yeast plant belongs to the family of Fungi, which are those plants that do not contain chlorophyll. A single plant is a round or oval single-celled plant. It grows only in the presence of moisture, warmth and nutritive material. During the process of bread-making the yeast works in the warm water and flour, feeds upon the sugar originally present or else produced from the starch of the flour by diastase, grows and spreads throughout the dough, at the same time, giving off carbon-dioxide, which forces its way up through the tenacious particles of the gluten and finally leavening the dough.

The cells composing the plant may occur singly or grouped together as colonies. When the cell reproduces, it becomes slightly elongated and forms a small projection at one end. This continues to grow until finally a neck is formed by the contraction of the cell wall. Growth continues until finally the cell wall completely shuts off the bud and it becomes a new cell. This is the process of budding. One cell may give off several in succession and after some time the energy is exhausted and the cell is then broken up.

When the yeast plant is placed in a condition where there is moisture, but has insufficient food, it does not grow by budding as is usually the case, but breaks up in several parts which are cell-like in structure and contain small bodies which are known as spores. Spores are capable of enduring considerable heat and drying without injury. The cell-like structure breaks and allows the spores to spread.

For baking purposes there are three commercial kinds of yeast, Brewers, Distillers Compressed, and Patent.

Brewers yeast is used quite extensively. It is a liquid yeast and grows in a brewers fermenting vats either as top yeast or as bottom yeast. The top yeast grows as a scum on the top, while the latter sinks to the bottom. The bread produced from this yeast has a different flavor which characterizes baker's bread.

A yeast commonly used by the housekeeper is the compressed yeast. It consists of a soft, soggy material composed of large quantities of yeast plants mixed with starch and other materials. This is what is known as distiller's yeast. It was originally distillers yeast which was placed in large vats containing nutriment upon which it fed. The yeast collects as a scum on the surface of the vat. It is removed, washed, and pressed and is then ready for sale. Compressed yeast is the most convenient and reliable type of yeast culture that has been produced. In the fresh cake nearly every plant grows and is satisfactory but has the disadvantage of not keeping long. Where it can be obtained fresh, it should be used. The expense of the amount necessary for household use is not enough to be considered, but when the baker uses it the expense is somewhat great.

This leads to what is known as patent yeasts or home-made yeast. It is prepared by cultivating the yeast plant, mixing the products with materials, usually starch, pressing into cakes and then drying them at a very lot heat. The process isjures or perhaps kills some of the plants but there are a large number left so that if placed under favorable conditions they will grow. While the dried cakes are not so convenient as the compressed, yet with a little experience they will give good results and also have the advantage that they do not need to be so fresh.

The one thing that determines the real value of yeast is its purity. In a great many cases the yeast cake contains impurities, sometimes in the form of bacteria and in some cases the yeasts contain other yeasts that those used in bread-making. These impurities may be present in a small or large quantity, but if present at all, will cause trouble.

Another thing that determines the value of yeast is its power of fermentation. Some types of yeast produce a more vigorous fermentation than others. As a rule when compressed yeast is fresh, it produces a more vigorous fermentation than the brewers yeast or the dried cake.

Yeasts may exist in three states, the resting state, the growing state and the spore-bearing state.

The yeast in the ordinary cake is an example of its being in a resting state.

When the resting state is placed in favorable conditions, that is when they have the proper food materials, moisture and temperature. All yeasts require sugar for food. Flour itself contains starch and is not fermentable, but in bread, some of the starch is changed to sugar by a chemical process so that fermentation may proceed. However yeast will not grow in a pure sugar solution.

The growth of the yeast plant depends to a considerable degree upon the temperature. They will grow rapidly at a warm ~~te~~ temperature ~~, temperatrapidly~~ less rapidly at a low temperature, and not at all, if the temperature is zero. The best temperature is from seventy-five degrees to ninety degrees Fahrenheit. Darkness aids the growth of yeasts.

The chief use of yeasts in the household is the process of bread-making. It causes the bread to rise by furnishing a source of carbon-dioxide which causes the dough to become swollen with gas and forms a bread that is well flavored, easily masticated, and easily digested.

Breadmaking.

- Good bread,
  - Conditions necessary
    - Good flour
    - Good yeast
    - Good manipulation.
    - Good baking.
- Faults of bread,
  - Caused by flour
  - Caused by yeast
  - Faulty manipulation
  - Faulty baking
  - Faulty care.
- Ideal Bread,
  - Baking
  - Taste
  - Appearance.

Breadmaking.

The kind of flour most commonly used in breadmaking, is that which is made from wheat. Good flour is necessary for the making of good bread. The properties of flour are color, strength and flavor. These properties largely determine the commercial value of a sample of flour. To determine the color of flour, compress a small quantity in a cake which has been dampened and allowed to dry. The color may then be observed. The flour having a yellow tint is of a high grade while a gray tint shows it to be of a low grade.

The strength of the flour is defined as the measure of the capcaity of flour to produce a bold, large-volumed, well-risen loaf.

The flavor of the flour is more a matter of taste than one of chemical analysis hence judgment of flour as to flavor is best made by actual consumer.

The water-absorbing power of flour may be defined as the measure of the water absorbed by the flour in order to produce a dough of definite consistency.

The constituents of flour are moisture, soluble extract, soluble proteids, crude gluten, ash, phosphoric acid, fat, and cellulose.

The second essential of good bread is good yeast. The yeast should be fresh as it loses its strength, which is its activity measured by the quantity of gas it evolves from a suitable saccharine medium.

Another important essential of good bread-making is good manipulation. The utensils used should be clean not only decency sake, but also the presence of foreign substances, change the taste. Foreign bacteria may also lead to fermentation. The temperature at which the bread rises best is the temperature at which the yeast plant grows best.

One of the conditions that accelerate fermentation is the greater the quantity of yeast, the more quickly it proceeds.

Soft flours tend to hasten fermentation; they contain more sugar and starch in a condition succeptible to diastase. Their proteid matter is more likely to act as a yeast stimulant, while the softness of the gluten lessens the physical obstacle to rapid action of yeast.

The action of water on fermentation is proportional to the quantity used. When doughs are slack, fermentation proceeds much more rapidly.

Temperature governs all. At a low temperature the yeast works very slowly if at all and with higher temperature fermentation is accelerated.

If bread is allowed to ferment too long, it sours. Souring of bread is not caused from this action alone, but also to the presence of foreign bacteria which produce acidity or putrefaction. The temperature of the oven and the time required for baking depends upon the size of the loaves. Small biscuits or rolls can stand a much hotter oven and quicker baking than large loaves which must be heated slowly and long. For ordinary purposes the oven should be heated 400° to 500° F. and one pound loaf bake from one hour to one hour and a quarter. An experienced cook can tell when the oven is hot enough by putting the hand in,but a pyrometer which is a thermometer for measuring high temperatures, makes a much safer guide for an ordinary person.

When the bread is taken from the oven, it should be placed on a rack so that the air can circulate around it, until thoroughly cooled. By that time all the gas and steam which are likely to escape have done so, the bread may be put away.

Some housekeepers wrap their hot bread in cloths but this is not advisable because it not only makes the bread taste of the cloth, but also because it shuts the steam up in the loaf and makes it damp and clammy - an excellent medium for the cultivation of mold.

One of the faults of bread is caused by the flour. The care of the grain previous to milling has a great influence over the starch granules. It should not be allowed to heat or mold in the bins, neither should it be stored in moldy places. If the wheat is exposed to moisture and allowed to sprout, the starch granules become lined more or less changed to dextrine. Flour made from such wheat produces bread that is heavy and will mold quickly.

Faulty bread may be caused from weak yeast. If yeast containing foreign bacteria is used good results will not follow.

Faulty bread will result from poor manipulation, as the use of unclean utensils, poor kneading, wrong temperature, and allow it to ferment.

An ideal loaf is one baked well throughout the loaf. The slightest yellow is a better color than snow-whiteness as the latter suggests lack of flavor, however color is a matter of individual taste. The texture of a loaf can best be seen by cutting it in two with a very sharp knife. The honey-combed structure of the bread should be as even as possible. The bread should not crumble away easily but be firm. On being gently pressed with the fingers, it should be elastic and should spring back without showing a mark, when the pressure is removed.

The gloss of the outside skin is called pile. The more unbroken it is the more silky in feel and gloss the higher the rank of the pile. A well piled loaf must be a well risen one.

Bread should have a nutty, sweet smell. This denotes a high degree of excellence.

The flavor is the most important test to which the bread can be put. Bread that pleases the palate is usually wholesome.- When tasting bread, a small piece should be placed in the mouth, masticated and allowed to remain there a short time before being swallowed. The flavor should be sweet and there must not be a sour or yeasty taste.

Bread should not clog or assume a doughy consistency in the mouth, neither should it be too dry.

The crust of the bread should be thin and of a rich-brown color.