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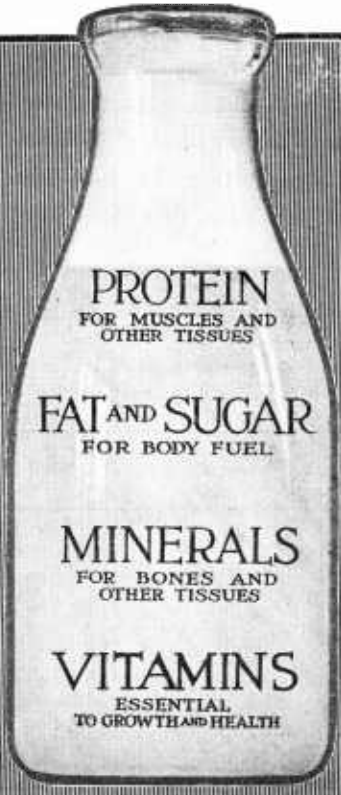
MILK AND ITS USES IN THE HOME



A SAFE, ABUNDANT MILK SUPPLY is recognized as an important factor in our national welfare. This department has previously published bulletins discussing milk as it concerns the farmer who produces it, the dealer who distributes it, and the manufacturers of butter and cheese. This bulletin discusses milk as a food from the point of view of the consumer, and shows why it is exceptionally important in the diet of children and a valuable food for adults. Suggestions for the care and use of milk are also included, as well as directions for pasteurizing it at home.

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Farmers' Bulletin 1207

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MILK AND ITS USES IN THE HOME.

Prepared by the Office of Home Economics, States Relations Service, with the cooperation of the Dairy Division, Bureau of Animal Industry.

CONTENTS.

MILK AND CREAM together, either by themselves or in combination with other foodstuffs, make up about one-sixth by weight of all the food eaten by the average American family. Milk supplies in particularly convenient and usable form materials that children need if they are to develop strong, normal bodies; and it is a valuable food for adults, especially when it is combined with such foods as cereals and green vegetables.

Almost all the milk and dairy products in this country, and in most other civilized countries where the climate is favorable, come from the cow. Cow's milk is no better than that of some other animals, but people are used to its taste, and cows make a good return for the feed and care which they receive. In parts of the world where cows do not thrive, other milk animals have proved satisfactory. Goat's milk, for example, is common in the rough, hilly districts of Europe, in Central America, and even in some parts of the United States. Buffalo's milk is much used in India, and llama's milk in South America. Camel's milk is well liked in desert countries, and mare's milk on the steppes of Russia and in Central Asia. Sheep's milk is used in Europe and elsewhere for making certain kinds of cheese, while the milk of the reindeer serves as food in the Arctic regions.

COMPOSITION AND FOOD VALUE OF MILK.

The milk ordinarily sold for household use varies in composition, principally because of differences between the breeds of cows and individuals of the same breed. On the average, however, milk contains 87 per cent water and 13 per cent solids, consisting of proteins, fat, sugar, and a variety of mineral substances (table, p. 5). Because of the natural variation, most creameries now test all the milk they buy and pay for it on the basis of fat content. For the same reason dairymen who supply the retail trade usually find it best to mix the milk from a herd of cows immediately after it is drawn. In this way the content of the milk is kept more uniform from day to day, which is a decided advantage to the consumer.

Unprincipled producers or dealers sometimes adulterate their milk, greatly changing its composition. Legislation and Federal, State, and municipal inspection, however, are making it more and more difficult to defraud the consumer in this way. The chief methods of adulteration are the addition of water, the removal of part of the fat, and the use of chemical preservatives, the first two of these

methods often being used together. These practices not only are fraudulent as regards money value, but they also diminish the food value.

Milk is slightly heavier than water, its specific gravity varying with the proportion of water, fat, and other substances. The specific gravity of milk is sometimes used as a test of its purity, but since removing part of the fat raises and adding water lowers the specific gravity, one form of adulteration may cover up the other and thus render this test alone unreliable.

As a rule milk freezes at about 29° to 31° F. The freezing point, however, varies with the composition, falling as the amount of solids becomes greater and rising as water is added. The freezing-point method is one of the most reliable for detecting the addition of water to milk.

The commission on milk standards of the New York milk committee, appointed to study and recommend uniform requirements among the different States and cities of the United States, has recommended the general adoption of the standard calling for not less than 3.25 per cent of milk fat and not less than 8.5 per cent of milk solids not fat. If all milk sold could be tested by such a standard, and the price regulated by the way in which the milk conforms to the standard, both producer and consumer would be better satisfied, the producer because he would get credit for rich milk, and the consumer because he would know what he was really buying. Such graded milk is sold in some European cities, and to a less extent in this country. The principle has been more commonly applied to cream, of which different grades are sold at prices varying with the proportion of fat. In addition to standards of chemical composition, many communities have adopted sanitary or bacteriological standards, and the milk is graded according to its purity.

Just what each of the nutrients as well as the vitamins contribute to the high food value of milk is discussed below in detail. Briefly stated, milk is an extremely valuable food because it contains, first, materials that children need for growth; second, materials that young and old alike need for the repair of their body machinery; and third, materials that all need for fuel, to provide them with heat and with the energy necessary for work. This does not mean, however, that milk has these ingredients in such proportions that it can serve satisfactorily as the only food of a grown person or even of a child. Since it contains such a high percentage of water, 5 or 6 quarts each day would be required to meet the needs of an adult if milk were his only food, and in this case unnecessary quantities of protein would be consumed. Also, grown persons and children past the normal nursing period need iron in greater abundance than is found in milk. The iron stored in the body of a new-born child is enough to enable it to live for a few months on that in milk, but older children and adults need more generous supplies, such as can be obtained from egg yolk, meat, whole cereals, and some fruits and vegetables. Furthermore, the digestive organs of healthy persons past babyhood do their best work when at least part of the food contains cellulose, or roughage, such as is found in vegetable foods. When combined with other foods, therefore, milk is used to best advantage, and in the diet of the growing child it is exceptionally important. Child specialists declare that each child should take at least a pint of milk each day, and most such authorities recommend a quart a day.

PROTEIN COMPOUNDS.

Protein compounds are necessary for the formation of body tissues and fluids and may also serve as body fuel. Protein in food takes different forms. For example, the protein of the white of egg consists largely of albumin, lean meat contains a protein compound known as myosin, and peas and beans contain one called legumin. The principal protein compound in milk is casein. Another important one is called lact-albumin, but this is present in much smaller quantities. All forms of protein contain nitrogen and all are made up of substances known as amino acids. The combination of amino acids found in the proteins of milk, eggs, meat, and other flesh foods is very like some of those in the human body. These are therefore of special value for tissue building, and are called adequate, or complete, proteins, and milk and the other materials that furnish them are sometimes grouped together as efficient-protein foods.

FAT.

Fats are the most concentrated fuel foods in the diet, and from the commercial standpoint fat is the most important substance in milk, since it is the source of butter and is an important constituent of many kinds of cheese. The fat of milk, known also as butter fat, is in the form of small globules varying in size in the different kinds of milk, and, being lighter than water, these globules tend to rise to the top of the milk as it stands, thus forming cream. Cream is not pure milk fat, but contains also some of the other substances in milk.

MILK SUGAR.

Milk sugar, or lactose, belongs to the group of nutrients called carbohydrates. Like cane sugar, it supplies energy to the body, but dissolves less readily and is much less sweet. Most of the milk sugar remains in the whey when the curd (casein) is removed in cheese making, and may be easily separated from it. Milk sugar is usually marketed as a fine white powder that looks like confectioner's sugar, and is used in modifying milk for babies, in the preparation of drugs, and in many other ways.

MINERAL MATTER.

Mineral constituents of milk that are especially important to the body are phosphorus, iron, and lime. Phosphorus is fairly abundant in milk. Although not much iron is present in milk, what little there is can be easily used by the body. Milk is much richer in lime, the chief constituents of bones and teeth, than are most other foods, and this is one of the reasons why it is an excellent food for children.

VITAMINS.

Vitamins are among the comparatively recent discoveries of science. Little is known about them or the part they play in the diet save that there are several kinds that are necessary for normal health and growth and that when they are left out of the diet for a long time so-called "deficiency diseases" develop. At least three kinds of vitamins are now recognized, which, until more satisfactory names are agreed upon, may be known as A, B, and C. All three of these vitamins may be present in milk.

Vitamin A is found only in certain foods, and in few so abundantly as in milk, especially from cows on pasture. This vitamin seems to be largely associated with the fat of the milk; therefore whole milk, cream, and butter are richer in this respect than are skim milk, buttermilk, and other milk products containing little fat. Other important sources of vitamin A are green-leaf vegetables, egg yolk, and the liver and other glandular organs of animals.

Vitamin B is found in many fresh foods, but not in highly refined ones such as white flour, cornstarch, polished rice, white sugar, and table oils. It is present in milk but not so abundantly as is vitamin A.

Vitamin C is less widely distributed and seems to lose its special value more easily than A and B. It is furnished by certain fruits and vegetables—for example, oranges and tomatoes—and to some extent by milk. Its value in milk, however, seems to be easily destroyed so that absolutely fresh, uncooked milk from pasture-fed cows is the only milk that should be relied on to supply it. The effect of heat on vitamin C is discussed on page 5.

DIGESTION OF MILK.

How easily and completely milk is digested depends upon the proportions of nutrients that the average normal person can assimilate. Since milk contains some of all classes of nutrients, the way in which it is digested can be better understood by following the changes in each nutrient separately.

Milk is commonly classed as a liquid food, and so it is until it reaches the stomach. There the rennin of the gastric juice converts the casein into a curd in much the same way that milk is separated into curds and whey in cheese making. The acid and the pepsin of the gastric juice, together working on the curd, make a small part of it more soluble, but most of the casein is digested in the small intestine. Lime water or barley water is sometimes added to milk for infants and invalids to prevent the formation of a tough curd, which may make digestion more difficult.

The fat of milk is also digested in the intestines and in the case of normal adults more easily than most other fats.[1] This is partly because milk fat has a low melting point, a fact that is believed to have important bearing on digestion of fats, and partly because it can be readily emulsified, or divided into particles that pass without difficulty through the walls of the intestines. For these reasons milk fat is considered especially suitable for invalids and children, but like any other fat may cause digestive disturbance if taken in too large quantities.

It is commonly supposed that the lactic acid of sour milk is changed to simpler bodies in the digestive tract. Its presence may be beneficial in checking the growth of bacteria that causes some kinds of intestinal disorders.

On the whole, milk is as well or even more thoroughly digested than other animal foods. When milk is the only food eaten by a healthy adult, decidedly less of its nutrients are digested than is the case when it forms a part of a mixed diet. Taking other food with the milk hinders the formation of lumps, or curd, of casein in the stomach and so makes the milk easier to digest. Of course, very

[1] U. S. Dept. Agr., Dept. Bul. 310, Digestibility of some animal fats.

young children digest mothers' milk alone better than any other food, because such milk is thoroughly adapted to their use. If other milk is substituted for mothers' milk, for best results it must usually be modified. For many adults in poor health, milk is an important food, and many persons whose digestive organs are not in good condition receive more benefit from it than from any other single food.

EFFECT OF COOKING.

Cooking affects the digestibility and food value of milk in some respects, changes the appearance and flavor slightly, and also destroys bacteria (p. 7).

The curd of boiled milk is finer and more easily acted on by the digestive organs than that of either raw or pasteurized milk, though it is commonly said to be more constipating. The fat globules also are somewhat altered, and cooked milk fat may be slightly less easily emulsified than the raw. The food value of the sugar in milk is not changed by ordinary cooking.

Vitamin C is very easily affected by cooking, in fact, even by the ordinary aging of milk. When boiled or pasteurized milk or milk powder is used to feed infants, it is safer to give with it orange or tomato juice, and some physicians hold that this is a wise precaution even with raw milk. Vitamins A and B seem to be less easily affected by cooking.

The film, or "skin" composed of protein and fat, that forms on milk, especially when cooked in an open vessel, is the most noticeable change in appearance, unless the heat is intense enough to caramelize some of the sugar. In this case the milk becomes brownish in color. The peculiar odor and flavor of freshly boiled milk seem to be partly due to changes in the protein.

MILK FOR INFANTS.

That the best food for an infant is milk from a strong, healthy woman is admitted by everyone. When this is not obtainable, the more nearly the substitute resembles it the better. Cow's milk is the most common substitute and when necessary may be artificially modified. Goat's milk, too, is in some cases recommended for infants. The composition of different kinds of milk is compared in the following table:

Average composition of milk of various kinds.

Kind of milk.	Water.	Protein.			Fat.	Carbohydrates (milk sugar).	Mineral matter.	Fuel value per pound.
		Casein.	Albumin.	Total.				
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Woman	88.3	.....	.....	1.2	3.3	7.0	0.3	285
Cow	87.0	2.8	0.5	3.3	4.0	5.0	.7	315
Goat	85.7	3.5	1.0	4.5	4.7	4.4	.8	355
Sheep	81.9	.....	.....	5.3	7.3	4.7	.9	480
Buffalo (Indian)	82.2	4.3	.5	4.8	7.5	4.8	.8	480
Camel	87.1	3.5	.4	3.9	2.9	5.4	.7	285
Llama	86.6	3.0	.9	3.9	3.2	5.6	.8	305
Reindeer	67.2	8.4	1.5	9.9	17.1	2.8	1.5	930
Mare	90.6	1.3	.8	2.1	1.1	5.9	.4	190
Ass	90.1	.8	1.1	1.9	1.4	6.2	.5	205

Cow's milk contains more protein, less sugar, and slightly more fat than woman's milk, and the fat globules are larger. Also it is said to form a tougher curd.

Fortunately, most healthy babies thrive on good cow's milk or on cow's milk simply modified. It is the sickly who require special preparations, and their needs vary so greatly that only the physician familiar with the case, and not always he, can say what change is necessary. There are laboratories in many large cities and towns where modified milk of all sorts can be procured on prescription.

The milk for babies should be the purest obtainable, and should be cared for scrupulously after it is delivered. In fact, it is usually more important that the milk for babies should be pure than that it should be especially rich, for the fat in very creamy milk may cause difficulty in digestion. Since raw milk may contain harmful bacteria, pasteurized milk is often considered safer forbabies. A home method of pasteurizing milk is described on page 7.

As a result of the demand for milk of unquestioned purity for children, certified milk may now be obtained in many towns and cities. This milk is produced and bottled under sanitary conditions, certified by a medical milk commission, and is labeled with a certificate that can be used only by establishments producing milk of a fixed standard of purity. Such milk justly commands a higher price than that of which the quality is not guaranteed. Certified milk, which is discussed in greater detail in another bulletin of this department,[2] should not be confused with so-called "sanitary" or "special" milk. These are terms applied somewhat loosely to milk produced and handled under conditions considered necessary to assure a pure, wholesome product, but they are sometimes applied by dealers, for purposes of advertising, to milk produced under decidedly insanitary conditions.

BACTERIA IN MILK.

Besides the chemical compounds, milk contains minute forms of life called bacteria, which enter it from many sources during milking and handling.

The most common types of bacteria in milk are those that cause it to sour by converting the milk sugar into lactic acid, and are of special importance in the making of butter and cheese. Others, as they develop, change the color of milk or make it slimy or ropy. Still others, though they seem to have no effect on the milk itself, may spread disease. The milk from tuberculous cows, for instance, is unsafe, because it may contain the bacteria causing tuberculosis. Typhoid fever and diphtheria may be transmitted through milk infected by bacteria-laden flies, by unclean utensils, or by persons who carry such bacteria in their bodies or on their clothing. Epidemics have sometimes been traced to the milk from a single farm. Practical measures for protecting milk from such contamination are discussed in another bulletin of this series.[3]

Milk is an ideal food for bacteria, and they multiply rapidly when the temperature is favorable. Most bacteria, however, are very sensitive to heat and cold, a fact of great practical importance in handling and marketing milk. Cooling milk to 50° F., immediately

[2] U. S. Dept. Agr., Bul. 1, Medical milk commissions and certified milk.
[3] U. S. Dept. Agr., Farmers' Bul. 602, Production of clean milk.

after it is drawn from the cows, is an effective way to check the growth of bacteria, and pasteurization is the most satisfactory method of destroying them by heat, without producing undesirable changes in the milk itself. Though disease-producing bacteria in milk are destroyed by this process, some other kinds survive; therefore pasteurized as well as raw milk should be kept cold until used in order to check any further development.

PASTEURIZATION OF MILK.

Though slight warmth is favorable to the growth of bacteria, long-continued and intense heat is fatal to them. Unfortunately, heat sufficient to destroy all varieties of bacteria also causes changes in the chemical composition and flavor of milk, as in boiled milk; otherwise cooking would be a simple and satisfactory way of preserving milk. Pasteurization is a common method of applying heat so as to destroy as many bacteria as possible without producing undesirable changes in the milk. Many cities now require that all except certified milk be pasteurized before sale.

In pasteurizing, milk is generally heated to 145° F., held at this temperature for 30 minutes, and then rapidly cooled. This treatment does not make the milk entirely free from bacteria, though when done by the best commecial method it destroys a large proportion of the bacteria present and delays souring. While efficient pasteurization destroys disease germs, such as those of tuberculosis, diphtheria, and typhoid fever, it is not an insurance against future contamination, and as great care should be taken of pasteurized as of unpasteurized milk.

HOW TO PASTEURIZE MILK AT HOME.

Milk and cream for ordinary use or milk for feeding infants may be successfully pasteurized at home. The process is not difficult and requires only simple equipment. A pail somewhat deeper than the bottles containing the milk and with a perforated false bottom is perhaps the most convenient utensil in which to heat the milk. An inverted pie tin with a few holes punched in it serves very well as the false bottom, its purpose being to raise the bottles from the bottom of the pail, allowing free circulation of water and preventing the bottles from bumping. A good thermometer with the scale etched on the glass is needed. The ordinary floating dairy thermometer is likely to be inaccurate.

For general use, milk is most conveniently pasteurized in the bottles in which it has been delivered. Pour out a little of the milk, replace the covers, punch a hole through the cap of one of the bottles, and insert the thermometer. Set the bottles of milk in a pail, fill with cold water nearly to the level of the milk, and heat the contents until the thermometer in the milk registers 145° F. Remove the pail from the heat and allow the bottles to remain in the water for 30 minutes, reheating if necessary to keep the temperature at 145° F. After the 30-minute period, replace the hot water gradually with cold until the temperature of the milk is down to 50° F. If necessary, use ice in the water to bring the milk to this temperature. After cooling, put the bottles in the refrigerator and keep them at 50° F. or less.

Milk for infants is best pasteurized in the nursing bottles in the quantity needed for each feeding. It is then in the most convenient form to use, and there is no possibility of contamination by pouring it into other bottles. It is customary to pasteurize enough at a time to last for 24 hours. Milk in these smaller bottles is pasteurized by a slightly different method from that used when it is in ordinary bottles. A wire or tin basket (Fig. 1) that holds the bottles upright in the hot-water bath and makes it possible to handle them all at one time and without scalding the fingers is a great convenience.

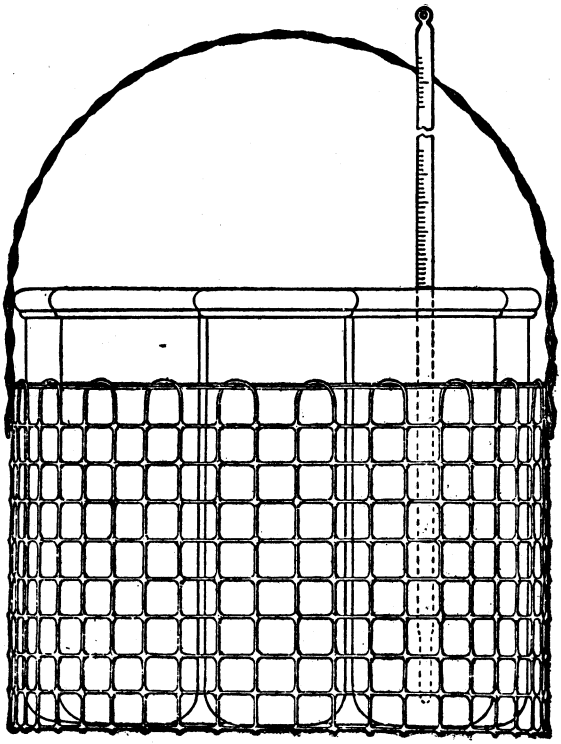

FIG. 1.—Wire basket with nursing bottles of milk ready for pasteurization. The bottles are covered with tight-fitting rubber diaphragms which should be left on until the milk is used.

Pour into each bottle the exact quantity of milk required for a feeding, after modifying it, if necessary, according to directions. It is wise to prepare an extra bottle, for there is always the possibility that one may be broken during pasteurization. Put the seals in place or plug the tops of the bottles with clean ordinary (not absorbent) cotton, and insert the thermometer in one of them. Place the bottles in the wire basket, set it in the pail, fill the pail with water nearly to the level of the milk, and heat until the thermometer in the milk registers 145° F. Remove the bottles, change the thermometer from the milk to the water, and add cold water until the temperature of the water is also 145° F. Put the bottles back into the water, cover with heavy cloth, and let stand for at least 30

minutes. Then cool the bottles as much as possible by running cold water into the pail, and store them in the refrigerator, or, still better, pack broken ice about them before putting them in the refrigerator. Remove the milk from the refrigerator, bottle by bottle, as needed. If a bottle is warmed and not used, discard it; do not return it to the refrigerator to be used for a later feeding.

CARE OF MILK IN THE HOME.

No matter how well milk has been handled up to the time it is delivered to the consumer, it can not be expected to keep well if it is then carelessly treated. Milk should be kept clean, covered, and cool; these three points consumer as well as producer should never disregard.

The best way of buying milk is in bottles. In this form it can be kept clean and cool more easily during delivery and is much more convenient to handle. Dipping milk from large cans and pouring it into customers' receptacles on the street exposes it to dusty air and is bad practice. Drawing milk from the faucet of a retailer's can is not quite so bad as dipping, but the milk is not kept thoroughly mixed and some consumers will receive less than their share of cream. By whichever of these methods the milk is measured, it should be delivered personally to some member of the household, if possible, or a covered vessel may be set out, such as a bowl covered with a plate, or better still, a glass jar, used for no other purpose, with a glass lid but without a rubber ring. Under no circumstances should an uncovered vessel be set out to collect thousands of bacteria from street dust before the milk is poured into it. Money and paper tickets are generally more or less soiled; hence neither should be put into the milk receptacle.

Sometimes milk delivered as early as 4 a. m. remains out-of-doors in a place exposed to sunshine and perhaps accessible to cats and dogs until 9 or 10 o'clock. This is wrong. If the milk can not conveniently be brought into the house at once, the delivery man should be asked to leave it in a sheltered place or in a covered box provided for the purpose. Even a temporary rise in the temperature of milk will help the development of bacteria that have been held in check by keeping the milk cool.

As soon as possible after delivery, milk should be put in a cool, clean place and kept there until used. Exposure to the air of pantry, kitchen, or nursery is harmful. Unless it is in the bottle into which it was put in the dairy, the milk should be poured into a freshly scalded vessel and covered.

The best temperature for keeping milk is 50° F. or less, and good milk kept as cool as that should remain sweet for 12 hours at least and ordinarily 24 hours or more, after it reaches the consumer. If ice can not be obtained, an iceless refrigerator or some such device is a help, even though a temperature as low as 50° F. can rarely be maintained in it.

In the ordinary refrigerator, unless the milk container is in actual contact with the ice, the milk will be colder at the bottom of the refrigerator than in the ice compartment, for cold air settles rapidly. The refrigerator should be kept clean and sweet at all times. It is a good plan to inspect it thoroughly at least once a week to see that

the outlet for water from the melting ice is open and that the space under the ice rack is clean. Also, the food compartments should be washed often with water to which washing soda has been added, for particles of food dropped in the refrigerator are likely to spoil and to contaminate other foods.

Sometimes in very hot weather housekeepers complain that, in spite of all precautions, milk sours quickly, even in the refrigerator. This is often due to the fact that the air of the refrigerator, although cool in contrast with the heat outside, is really not cold enough to check the growth of the bacteria in the milk. If a thermometer placed inside registers more than 50° F., the fault can not be laid entirely to the quality of the milk.

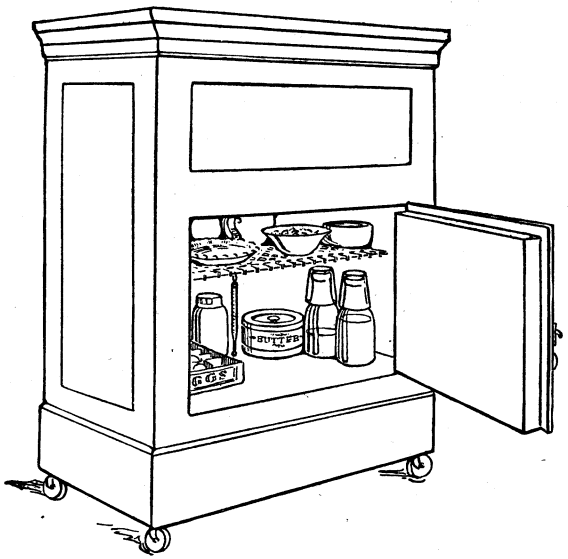

FIG. 2.—Proper arrangement of foods in a refrigerator. Milk, butter, and eggs are in the coldest part, and foods of pronounced odor on the upper shelf.

Milk should be kept covered to exclude not only dirt and bacteria, but also flavors and odors, which it readily absorbs. It should be kept away from such foods as onions, cabbage, or fish.

Bottled milk should be kept in the bottle in which it is delivered until needed for use. In fact, from a sanitary standpoint, serving milk on the table in the original bottle is an excellent practice. In any case a milk bottle, especially the mouth, should be cleaned carefully before the milk is poured from it, and only what is needed for immediate use should be poured out at a time. The bottle should be kept covered with a paper cap or an inverted tumbler as long as there is milk in it.

New milk should never be mixed with old unless it is to be used at once; the old milk is likely to contain a larger proportion of bacteria and to be warmer. Some persons even go so far as to say that milk or cream that has been exposed to the air by being poured into other vessels for table or cooking use should not be poured back into the general supply.

MILK PRODUCTS.

The average composition of various milk products, as compared with that of whole milk, is shown in the following table:

Average composition of milk and milk products.

Product.	Water.	Protein.	Fat.	Carbohydrates.	Mineral matter.	Fuel value per pound.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Calories.*
Whole milk	87.0	3.3	4.0	5.0	0.7	315
Skim milk	90.5	3.4	.1	5.1	.7	165
Cream	74.0	2.5	18.5	4.5	.5	880
Buttermilk	91.0	3.5	.5	4.2	.8	160
Whey	93.4	.8	.3	4.8	.7	115
Condensed milk, sweetened	28.0	7.8	9.0	53.5	1.7	1,480
Condensed milk, unsweetened	73.0	7.0	8.0	10.5	1.5	645
Skim-milk powder	4.0	35.0	2.0	51.0	8.0	1 640
Whole-milk powder	4.0	25.5	29.0	36.0	5.5	2,300
Butter	13.0	1.0	83.0	.....	3.0	3,410
Cheese (American, cheddar)	33.5	26.0	35.5	1.5	3.5	1 950
Cheese (Swiss)	31.4	27.6	34.9	1.3	4.8	1 950
Cottage cheese (skim milk)	69.8	23.3	1.0	4.0	1.9	535
Kephir	89.6	3.1	2.0	4.5	.8	220
Koumiss	90.7	2.2	2.1	4.1	.9	200

SKIM MILK.

Although skim milk contains much less fat than whole milk and therefore is not so rich in flavor, it has as large or larger proportion of protein, carbohydrate, and ash. Even after most of the fat is removed from average milk, the remaining solids make up nearly one-tenth of its weight. Moreover, in the ordinary mixed diet enough fat is supplied by meat, butter, lard, and in various other forms, so that the loss of this ingredient is of relatively little importance. Protein, on the other hand, is the most costly of the nutrients and the one most likely to be lacking in inexpensive meals, and skim milk supplies this in a cheap and useful form. Skim milk, therefore, may greatly increase the nutritive value of the diet if freely used in cooking or as a beverage in case the supply of whole milk is limited.

CONDENSED AND EVAPORATED MILK.

When milk is heated the water in it is readily driven off, and if the heating is continued long enough, the milk becomes thick and creamy. Advantage is taken of this fact in the manufacture of condensed and evaporated milk. On a commercial scale the process is commonly carried on in vacuum pans, as under such conditions a lower degree of heat may be employed and the danger of scorching is lessened.

Commercial sweetened condensed milk is usually made by adding cane sugar to fresh milk, heating the milk to dissolve the sugar, and then evaporating the whole until its bulk is about one-third that of fresh milk. The low water content and the large proportion of sugar do not favor bacterial growth; therefore, condensed milk will keep for a fairly long time after the can is opened.

Evaporated milk, as known in the trade, is whole milk that has been condensed in a vacuum pan to about one-half of its original volume without the addition of sugar. After it is drawn from the

vacuum pan, it is put through a homogenizer to break up the fat globules, so that they will not separate on standing. The milk is then placed in sealed cans and exposed to steam under pressure. The temperature must be sufficiently high and the exposure long enough to destroy all bacteria in the milk. In this process a soft curd is usually formed, and after the milk has cooled the cans are shaken vigorously to break up this curd and give the milk a creamy consistency. If properly made, evaporated milk contains no bacteria and unopened will keep indefinitely. After opening it must be handled carefully, for like fresh milk it is liable to become contaminated with bacteria.

Both condensed and evaporated milk may be used in cookery and in many other ways like fresh milk, and they are particularly convenient in situations where fresh milk can not be obtained or is limited in supply. The comparatively small bulk is also an advantage in shipping.

DRIED MILK OR MILK POWDER.

Dried milk is the solids of milk from which practically all the water has been removed. It is, in fact, the most concentrated form in which milk is now marketed, and hence is convenient for storage and shipment. One hundred pounds of fresh milk, it is estimated, can be reduced to about 12½ pounds of fine powder or flakes containing all the protein, fat, sugar, and minerals of the liquid milk. Because of the tendency of milk fat to become rancid, at least part of it is often removed before milk is put through the drying process, but dried whole milk is now being successfully produced and distributed. Though the skim-milk powder has the advantage in keeping quality, dried whole milk has about 40 per cent higher fuel value because of the fat. Under the Federal Food and Drugs Act, dried whole milk must contain not less than 26 per cent milk fat, and not more than 5 per cent moisture.

Dried milk mixed with the right proportion of water looks and in some cases tastes very much like fresh milk, though the flavor depends to a great extent on the method of manufacture and the age of the powder. In food value, also, dried milk restored to liquid form compares favorably with fresh milk, except perhaps in vitamin content. According to experimental data published by the United States Public Health Service [4] and other agencies, dried-milk powders, like any other kind of heated milk, may lack vitamin C, and if used in feeding infants another food rich in this vitamin, such as orange or tomato juice, should be given as a safeguard. The skim-milk powders are also deficient in vitamin A, because it has been largely removed with the fat. In general, dried milk, like the condensed and evaporated forms, is of greatest value where fresh milk is difficult or impossible to obtain.

RECONSTITUTED MILK.

Reconstituted, or reconstructed, milk, as it is sometimes called, is obtained by blending together the constituents of milk previously separated. It is made from skim-milk powder, sweet, unsalted butter, and pure fresh water, or from whole-milk powder and water, or from

[4] U. S. Treas. Dept., Public Health Serv., Public Health Rpts., vol. 37, No. 40, pp. 2415–2433, Dried milk powder in infant feeding.

evaporated or skim milk as a basis with any additional preparation of milk fat to give the desired richness. Sanitary precautions are just as necessary in handling reconstituted milk as if it were fresh. In situations where the transportation of so bulky and perishable a food as fresh milk is a problem, reconstituted milk may be a convenience and economy, since only the solids need be shipped.

CREAM.

Cream contains the same constituents as milk, the chief difference being that in cream the proportion of fat is greater. Though cream is often added to a soup, sauce, or dessert, chiefly to improve flavor and texture, it should be remembered that the food value of the dish is increased as well. Ordinarily cream is one of the most easily and thoroughly digested of the common fat foods, but like any other concentrated fat may cause disturbance if eaten in overlarge quantities.

The heat necessary in pasteurizing cream causes it to lose some of its body and sometimes to separate slightly; therefore in order to prevent these effects many dairies now homogenize their cream before pasteurizing. By this mechanical process the fat globules are made so fine that they show no tendency to rise to the surface, an advantage except in the case of cream for whipping. For this purpose raw cream, which has been neither pasteurized nor homogenized, has proved best. The effect of these processes as well as of other conditions on the whipping quality of cream is discussed in another publication.[5]

Devonshire clotted cream, not so well known in the United States as it deserves to be, has a nutty flavor that combines especially well with fruits and various desserts. It is prepared as follows: Vessels of milk on which the cream has been allowed to rise undisturbed are heated slowly and cooled, and the thick clotted cream is then skimmed off. This process not only develops a characteristic flavor but checks development of bacteria, so that clotted cream keeps better than ordinary cream.

BUTTER.

Butter, or in other words milk fat in a very condensed form, is one of the most palatable and digestible fats in our diet. Moreover, it also has special food value because it contains vitamin A. The flavor, color, and texture of butter influence price to some extent, but affect quality rather than composition, and so far as is known have little effect on nutritive value or digestibility. They are also an index of care and cleanliness in making and handling butter.

More detailed information on the food value of butter and its economical use in the home is given in another publication of the department.[6]

BUTTERMILK.

Strictly speaking, buttermilk, is the mildly acid liquid left after the fat globules of milk or cream have been churned into butter and removed. Buttermilk, however, is also manufactured by ripening pasteurized skim milk with lactic-acid cultures and then so stirring

[5] U. S. Dept. Agr., Dept. Bul. 1075, The whipping quality of cream.
[6] U. S. Dept. Agr., Dept. Bul. 469, Fats and their economical uses in the home.

the curd that it is broken up into fine particles, just as by churning. In fuel value buttermilk, whether a by-product of butter making or manufactured with cultures, is very similar to skim milk. The casein of buttermilk, however, is often more easily digested than that of ordinary milk, and for this reason carefully prepared buttermilk is sometimes a food of special value for babies and invalids. Though most often served as a beverage, buttermilk may be used in practically the same way as sour milk in cookery, and can also be made into ice cream.

CHEESE.

The nutritive value of cheese and its uses in the diet, as well as home methods of making some kinds of cheeses, are discussed in other publications of this department.[7]

WHEY.

Just as buttermilk represents what is left from cream in butter making, so whey represents what is left from milk in cheese making. Though less nutritious than buttermilk and skim milk, since it contains less protein, whey may be substituted for them in making bread and other cooked foods, and it is also useful in some cases as a mild laxative drink for invalids.

Whey that differs little in composition from regular cheese whey, may be made at home by cooking sweet milk with some acid material, such as vinegar, lemon juice, or cream of tartar, or even with sour milk. Fresh curds and whey is an old-fashioned dish still used to some extent, though less common than it was when cheese making was regularly carried on in the home.

SOUR MILK AND CLABBER.

The lactic-acid bacteria normally present in milk cause it to sour quickly if not held at a low temperature. As the milk curdles from the effect of the acid, it gradually becomes semiliquid or "clabbered." Usually no special methods are followed in preparing clabber other than allowing the milk to stand undisturbed until it curdles. If the souring takes place too slowly, however, the clabber may have an unpleasant flavor due to the growth of undesirable bacteria. Sour milk and clabber are widely used in cookery, and, like sweet milk, add to the food value of many dishes.

KEPHIR, KOUMISS, AND OTHER FERMENTED-MILK PRODUCTS.

Since earliest times fermented-milk products, made from the milk of various animals, have been used as beverages and articles of diet in central Asia, Turkey, and other countries. These products are prepared by allowing special ferments or yeasts to develop in milk and the carbon dioxid produced makes the fermented milk effervescent. The flavor differs with the process of manufacture. Fermented-milk beverages may be made at home, but are perhaps more commonly commercial products in the United States.

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[7] U. S. Dept. Agr., Farmers' Buls. 487, Cheese and its economical uses in the diet; 850, How to make cottage cheese on the farm; 960, Neufchâtel and cream cheese: Farm manufacture and use; 1191, Making American cheese on the farm.

These fermented-milk products contain lactic-acid-forming bacteria in great abundance, and their extensive use has been much discussed, owing to the prominence given to the theory that many disorders, particularly those that come with old age, are the results of the development of certain bacteria in the intestine and that the growth of such organisms may be hindered by the presence of lactic acid. The most recent observations, however, make it doubtful whether such soured milk is as beneficial as has been claimed by some enthusiasts, though it has proved of value in invalid dietetics.

A carbonated milk, made by charging milk with carbon dioxid, is sometimes found on sale, but of course lacks the special qualities of the fermented-milk products.

SPECIAL INFANT FOODS.

Of the many patent infant and invalid foods on the market, some consist of cow's milk combined with varying amounts of carbohydrates or other materials and others seem to be made of starchy materials without milk. In some cases the carbohydrates have apparently been malted before being combined with milk, or else malt extract is added during the process of manufacture.

Experience has shown that these special foods, when they contain nutrients of milk, are sometimes valuable for infants when it is necessary to resort to artificial feeding. Too much faith should not be put in the extravagant claims made for some brands of infant foods. The safest course is to follow the advice of a competent physician in selecting the substitute for natural feeding. It is often wiser to use cow's milk, modified at home under a physician's directions, rather than these commercial foods.

USE OF MILK IN COOKING.

If freshly used in the preparation of other foods, milk can be made to add greatly to the food value of the meals. A dish is, of course, richer if whole rather than skim milk is used, but the value of skim milk should not be overlooked, for it contains not only the protein but practically all the other nutrients of milk except the fat. The following suggestions apply to the use of either whole or skim milk.

SOUPS.

Milk soups are an excellent way not only of serving milk but also of utilizing left-over portions of vegetables and other foods. In making these soups, allow to each cup of liquid (including milk and the juice and pulp of vegetables) about one-half tablespoon of flour and one tablespoon or more of butter or other fat. Some of the flavorings that may be used are onion, corn, asparagus, cabbage, cauliflower, peas, potatoes, beans, tomatoes, celery, spinach, salmon or other fish, or grated cheese.

Often children who do not like milk to drink will relish it when combined with a favorite vegetable and served as soup, and in this way may be induced to take the desired amount of milk each day. Moreover, there is peculiar fitness about thus combining milk with vegetables. Many vegetables are rich in iron and vitamin C, while milk does not furnish either of these abundantly.

The following method of making milk-vegetable soups so as to conserve mineral substances and vitamins is particularly desirable if the supply of green vegetables is limited. It is also a good way of making soup to be given to children, for although a watery soup is often appetizing, so small a portion as a child usually eats provides little nourishment. The raw vegetables are chopped fine and then cooked in little or no water just long enough to make them tender, and the milk and thickening are added. All the liquor is thus utilized without greatly diluting the milk, and the brief cooking tends to prevent destruction of vitamins. Egg yolks added to milk-vegetable soups just before they are served make them still richer in protein, fat, iron, and vitamin A.

CHOWDERS.

Fish chowders are also an appetizing way of serving milk. The proportions are 2 cups of milk or of milk and water, 1 cup of potatoes cut into small pieces, 1 pound of fish, and 4 large crackers. Onions and fat from salt pork are usually added for flavor. These proportions make a rich dish, and good chowder can be made with less fish.

Other dishes that resemble chowders, and are often incorrectly so called, can be made by substituting for the fresh fish small portions of left-over fish, salt codfish, or dried beef. The so-called vegetable chowders have corn, lima beans, sliced carrots, or other vegetables in place of the fish.

CREAMED DISHES AND GRAVIES.

The foundation of creamed dishes is white sauce made of milk, butter, flour, and seasonings. For a sauce of medium thickness the proportions are: 1 cup of milk, 2 tablespoons butter, and 2 tablespoons flour. These ingredients may be combined in several ways, but the following method is economical of time and utensils and yields a rich, smooth sauce. Blend the flour with the butter which has been melted but not allowed to brown, add the milk carefully, and stir the mixture constantly until it thickens and begins to boil. The sauce is then ready to combine with a cooked vegetable, such as cauliflower, diced potatoes, or celery, with hard-cooked eggs, or with chopped meat or fish. Adding grated cheese to the white sauce for many creamed dishes gives them richer flavor as well as greater food value. A rich cheese sauce of this kind poured over crisp toast makes a satisfactory lunch or supper dish, especially if served with a succulent vegetable.

Milk gravies are made in the same way as white sauce, except that drippings from bacon, chicken, ham, or other meat are substituted for the butter.

BEVERAGES.

Milk may be used as the basis of a great variety of hot and cold beverages that are about equal to milk itself in food value but are more pleasing in flavor to persons who do not like to drink plain milk. Moreover, children and others who need milk in large quantities enjoy having it served occasionally in unusual ways. The food value of these milk beverages depends, of course, on the kind as well as the proportion of both milk and flavoring used.

Chocolate and cocoa are probably the most popular flavorings for milk beverages, for they combine well with either whole or skimmed fresh milk or with the milk reconstituted from the dried, evaporated, or condensed products. Moreover, these chocolate-flavored milk beverages are good served either hot or ice cold, and they are easily and quickly made at home. For young children, cocoa is considered preferable to the stronger, richer chocolate.

Café au lait, which is merely hot milk flavored with a little very strong coffee, has greater food value than ordinary coffee and cream, and many persons prefer it as a breakfast beverage.

Vanilla, almond, and other household flavoring extracts, caramel or maple sirup, fruit juices and sirups, and some of the common spices, are also satisfactory flavorings if thoroughly blended with the milk.

Somewhat effervescent milk beverages of pleasing flavor may be made at home simply by adding to cold fresh milk small quantities of ice-cold ginger ale, sarsaparilla, or some of the other bottled soft drinks.

Eggnog, made by beating together milk, egg, and the desired flavoring, is a particularly nutritious drink, since it combines two foods rich in protein and minerals.

The proportion of flavoring material to use in these milk beverages depends on individual taste, and definite proportions can be worked out by a few experiments. For children and invalids they should generally be flavored rather delicately. Shaking or beating milk drinks until they are frothy when served adds to their attractiveness.

DESSERTS.

There is almost no end to the puddings and desserts in which a large quantity of milk may be used.

Junket is one of the simplest and most wholesome, for it is merely sweet milk thickened to custard-like consistency by means of a rennet preparation. Caramel, maple, and almond, as well as vanilla, are good flavorings for junket, or crushed fresh fruits or fruit sirups may be served with it for variety.

Sweet curd, made in the same way as junket, except that the thickened milk is broken up and strained, may be used as the basis for filling for pies and tarts. To the curd from 1 quart of milk, add 1 tablespoon of butter, ¼ cup of sugar, 2 egg yolks, a few dried currants or chopped raisins, and the desired spice.

Milk sherbets, frozen custards, and ice creams are all ways of serving milk and cream in a form that most persons find attractive and refreshing, particularly in hot weather. The food value of these frozen-milk desserts depends, of course, on the proportion of milk or cream to flavoring material, a fact that should not be overlooked, especially when they are served to children.

Many kinds of nutritious puddings may be made by slowly baking sweetened milk with a cereal, such as rice, corn meal, or buttered bread, and raisins or some other dried fruit or a spice for flavoring. Old-fashioned creamy rice pudding has long been a favorite of this type, and is easily made by adding 1 tablespoon of rice and the desired seasoning to 1 quart of milk and baking the mixture slowly until it thickens to a creamy consistency and the rice grains are soft

and several times their original size. These milk puddings may be served either hot or cold and with or without cream or a sauce. Hot Indian pudding served with ice cream is a favorite combination in New England.

There are also the custards, of which milk and eggs are the chief ingredients, and the Bavarian, Spanish, and other creams, which consist chiefly of milk or cream flavored in various ways and stiffened with gelatin. Many of these custards and creams, if carefully made, are especially suitable for children and invalids.

Blancmange and cornstarch pudding are still other dishes made chiefly of milk. These, too, may be varied almost indefinitely by the use of different flavorings or by serving them with sauces made of fresh or canned fruit.

SUMMARY.

Milk is one of the most important foods, in spite of the fact that it is about seven-eighths water. It excels almost all other foods in the variety and quality of materials that it furnishes the body, and is suitable for persons of all ages.

The solids of milk include protein, fat, sugar, and mineral matter, all in such form that they can easily be utilized in building and repairing the tissues and bones of the body. Milk is far richer in lime, for example, than other common foods, which makes it especially valuable for young children.

Fresh whole milk also may contain all three of the vitamins, constituents of certain foods found by scientists to be necessary for the maintenance of health and normal growth. Milk fat is frequently the most readily available source of vitamin A, which children must have in order to grow and develop normally.

Milk is one of the easiest of all foods to digest for the normal healthy person and for many invalids as well.

Certified milk often recommended for children is a special grade produced in establishments rigidly inspected and vouched for by a medical milk commission, and must therefore conform to a high standard of purity.

Milk should be kept clean, covered, and cool in order to prevent the bacteria in it from developing and causing it to spoil.

Even milk that looks clean may contain germs of such diseases as typhoid fever, tuberculosis, and diphtheria, if drawn from diseased cows, if handled by persons carrying the germs of these diseases, if the utensils and containers are washed in polluted water, or if the milk is contaminated by flies.

Pasteurizing milk, or holding it at a temperature of 145° F. for 30 minutes, is the best practical method of destroying disease-producing bacteria without causing undesirable changes in the milk. Milk for general use or for infant feeding can be successfully pasteurized at home, and this should be done if there is any question about its purity.

The consumer must share with those who produce and handle milk the responsibility of keeping it sweet and pure until used. It must be kept in a clean, cool place free from undesirable odors and put only in scrupulously clean vessels.

The care of the refrigerator plays an important part in the keeping quality of milk stored in it. It should be inspected at least once a week and thoroughly cleaned at regular intervals.

Skim milk, although lacking in fat, is a highly nutritious food, especially useful in cooking or combining with other foods. It contains practically all the protein, sugar, and mineral matter of the whole milk.

Condensed, evaporated, and dried milk may be used for many purposes in place of fresh milk when the latter is not available. For feeding children, these preparations may not, however, entirely take the place of fresh milk, and should be supplemented by fruit juices and fresh green vegetables.

The fat in cream and butter is very thoroughly and easily digested and carries with it relatively large amounts of vitamin A.

Soups, beverages, and desserts made chiefly of milk are appetizing ways of serving it, especially for persons who do not like to drink plain milk.

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