7-1938

Ice Cream Production in Nebraska.

Walter Kollmorgen
University of Nebraska-Lincoln

ICE CREAM PRODUCTION IN NEBRASKA

BY

WALTER KOLLMORGEN

Research Assistant

Conservation and Survey Division

The University of Nebraska

BULLETIN 18

CONSERVATION DEPARTMENT

OF THE

CONSERVATION AND SURVEY DIVISION

UNIVERSITY OF NEBRASKA

Printed by Authority of the State of Nebraska

Lincoln, Nebraska

July, 1938

ICE CREAM PRODUCTION IN NEBRASKA

BY

WALTER KOLLMORGEN

Research Assistant

Conservation and Survey Division

The University of Nebraska

BULLETIN 18

CONSERVATION DEPARTMENT

OF THE

CONSERVATION AND SURVEY DIVISION

UNIVERSITY OF NEBRASKA

Printed by Authority of the State of Nebraska

Lincoln, Nebraska

July, 1938

THE UNIVERSITY OF NEBRASKA

EDGAR A. BURNETT, Chancellor

BOARD OF REGENTS

HON. STANLEY D. LONG, Grand Island
HON. FRANK J. TAYLOR, St. Paul
HON. MARION A. SHAW, David City
HON. CHARLES Y. THOMPSON, West Point
HON. ARTHUR C. STOKES, Omaha
HON. ROBERT W. DEVOE, Lincoln

CONSERVATION AND SURVEY DIVISION

G. E. CONDRA, Dean and Director

As defined by law, the Conservation and Survey Division of the University includes the following state departments and surveys: Soil, Geological, Water, Biological, Industrial, Conservation, and Information Service. Its major purpose is to study and describe the state's resources and industries for use in development. Reports are published in three series, i.e., Nebraska Soil Survey, Nebraska Geological Survey and the Conservation Department.

TABLE OF CONTENTS

Ice Cream Production in Nebraska

Ice cream has had a long and varied history. It is reported that the illustrious Marco Polo in the fifteenth century learned the making of water ices and milk ices from the Japanese, and that he carried this information back to Europe.[1] It is definitely known that the Europeans knew how to make water ices in 1550, and that gradually milk and cream were added to such mixtures.[2] By 1774 an ice cream somewhat similar to our present product was known in Paris.[3] By this time the Italians had learned the secret of increasing the chilling and freezing potency of water and snow by the addition of saltpeter.[4]

The secret of making ice cream was brought to the United States by the early immigrants. Small quantities of this food were made and sold shortly after the Revolutionary War. The first advertisement of the product in this country appeared in 1786 in a New York paper and read as follows: "Ladies and Gentlemen may be supplied with ice cream every day at the City Tavern by their humble servant Joseph Crowe."[5] The first person to wholesale ice cream was Facob Fussell, a dairyman in New York County, Pennsylvania. At first Mr. Fussell converted merely his surplus milk and cream into ice cream. So profitable did this practice become that he shortly abandoned his milk trade and developed a flourishing ice cream business.

Compared with present day conditions, the ice cream industry continued to remain greatly restricted in scope and operation until the beginning of the present century. Among other things, a series of inventions were needed for the proper development of the industry. Important among these inventions were the centrifugal separator, the Babcock test, mechanical refrigerators (including the brine freezer), and the homogenizer. A great number of "perfecting" inventions, too numerous to mention in this bulletin, have also been made in the last two decades. Improved mechanical devices have become available so frequently that few ice cream producers find it financially possible or expedient to obtain all of them. A certain minimum plant equipment is necessary to produce good commercial ice cream, and it is with this minimum that we will concern ourselves. In point of time Nebraskans enjoyed home-made ice cream prior to the advent of the commercially produced product in this state. A brief consideration of this home product is therefore in order.

---

[1] Turnbow, Grover Dean, and Roffetto, Lloyd Andrew, *Ice Cream,* New York, John Wiley and Sons, Inc., 1928. p. 1.

[2] Sommer, Hugo H., *The Theory and Practice of Ice Cream Making,* Milwaukee, Olson Publishing Co., 1932. p. 1.

[3] *Idem.*

[4] Turnbow and Roffetto, *op. cit.,* p. 1.

[5] *Ibid.,* p. 2.

Home-Made Ice Cream

Ice cream was made on rare occasions in Nebraska homes as early as conditions became somewhat settled among the early pioneers. This applies particularly to the 1870's and 1880's, when small trading posts and villages were established and when railroads arrived to provide means of transportation. In these early trading centers the village butcher and the saloon keepers soon established themselves. Butchers and saloon keepers needed ice during the warm periods of the year to preserve or render palatable the products they handled; hence ice was stored in winter in ice houses and ice caves. They made liberal use of saw dust to preserve the ice. The use of ice for refrigeration in the home was uncommon during this early period. However, it was purchased on rare occasions when ice cream was to be made in the home. The Fourth of July was ice cream day during this early period. Weddings and perhaps certain family anniversaries that occurred in the warm period of the year were also distinguished by the serving of this food. It represented the ultimate in a tasty delicacy. Ice cream continued to be looked upon as a rare dainty and was produced sparingly practically up to the period of the World War.

Methods of Making Ice Cream in the Home. The first step in making ice cream is to prepare the fluid mixture, commonly spoken of as "mix." The mix as prepared today for the home freezer is not unlike the mix prepared by the early domestic ice cream makers. Such a mix contains milk and cream in various proportions, sweetening, and flavoring. It may also contain beaten eggs or corn starch.

Freezing the mix by the ice-and-salt method is variously accomplished. In all cases the ice is broken or chipped to fragments so that it can easily be packed about the container holding the mix. A generous amount of salt is sprinkled between the packed ice to increase its freezing qualities. The mix may be frozen in a still or placid state, or it may be agitated during the freezing process. When the mix is frozen by the still or placid method, it is put into a tin container, such as a molasses or syrup bucket, and placed in ice and salt. Since the mix freezes from the margins to the center, that at the margins should be scraped off periodically and mixed with the unfrozen part.

Agitation in some form is desirable during the freezing of the mix, as it assures a more uniformly frozen product and also serves to incorporate air into the mix, rendering it light and more palatable. The simplest form of agitation is accomplished by gripping the handle of the bucket containing the mix and partially rotating in alternate directions while the container is in the ice and salt. The bucket should be opened at times and the contents thoroughly stirred with a spoon. This method accomplishes but little of the whipping essential to product a light ice cream.

The hand-freezer method of making ice cream in the home became rather common prior to 1900. It is still used extensively, particularly in rural areas. This method, by providing a maximum of agitation in the mix in its freezing state, causes uniform freezing and whips varying amounts of air into the product, thereby producing a light, tasty food.

Home Refrigerator Ice Cream. Since 1925 artificial refrigerators in the home have become popular. Besides offering refrigeration for a variety of foods, the appliance lends itself to making ice cream and ices. Surveys that have been made indicate that home refrigerators are used rather extensively to prepare frozen desserts. The ease with which a variety of such frozen delicacies can be prepared makes this feature of the refrigerator rather attractive.

Some ingenuity is necessary to prepare light, palatable ice cream in a refrigerator. The absence of agitation permits the crystals of ice in the mix to grow to considerable size. This makes it advisable to stir the freezing mixture several times to break up the growing ice crystals, which impart a coarse texture to the cream.

With the effects of stirring the mix by hand somewhat limited in the mechanical refrigerator, the housewife needs to resort to other methods to keep the crystals limited in size. This can be accomplished in part by the addition of proper ingredients. The addition of whipped eggs, cream, evaporated milk, egg yolks, or a little dissolved gelatin helps to improve the texture of the product. Mixtures of a higher solids content are usually smoother than mixtures less rich. By closely following the directions of refrigerator ice cream recipes, a housewife should not experience difficulty in preparing palatable, frozen desserts.

The Composition and Body of Home-Made Ice Cream. The composition and body of home-made ice cream is quite different from that of commercial ice cream. Milk and cream represent the main ingredients of home-made ice cream. These have a low content of serum-solids (non-water and non-fatty constituents) when compared with commercial ice cream mixes in which condensed milk products are used. As a result, home-made ice cream usually contains a greater percentage of water. The greater the water content of an ice cream mix, the less smooth is the resultant frozen product because, upon freezing, water forms into crystals of varying size. According to Sommer, home-made ice cream according to the usual recipes has the following composition:[6]

Fat	10.0 to 14.0 per cent
Serum solids	6.0 to 6.5 per cent
Sugar	13.0 to 16.0 per cent
Gelatin	0.0 (usually, or 0.25 to 0.5 per cent)
Fresh eggs	2.0 per cent

[6] *Op. cit.*, p. 12.

It will be noted that, in the above composition, there is a total solid content varying from about 30 to nearly 40 per cent. Since the average commercial ice cream mix usually contains about 40 per cent solids,[7] it follows that the latter product is usually richer in food value than is home-made ice cream.

Commercial Ice Cream Production in Nebraska

According to F. G. Caldwell,[8] one of the pioneer ice cream manufacturers of the Middle West, Nebraska had only three ice cream plants in 1900. Two of these concerns were in Omaha and one was in Lincoln. The absence of the proper kind of machinery made ice cream production a long and rather tedious job. In the main, the equipment required to make ice cream consisted of the steel ice cream can, freezers—similar to the hand freezers of today, but larger in size and powered by machinery—freezing tanks, and wooden packing tubs. After the mix was prepared, it was poured into the steel cans and partially frozen in the power freezers. After this it was removed from the freezer and packed in salt and ice in large hardening tanks. These were common up to 1906-7. At this time hardening tanks were introduced that contained circulating calcium brine. By 1910 the present system of hardening rooms with circulating cold air made its appearance in this section of the country.

The absence of ice cream cabinets prior to 1907-8 made ice cream a highly perishable product. For this reason it was the general practice among retailers to obtain ice cream for sale only on week ends (Friday, Saturday and Sunday) or for special holidays, particularly those occurring in summer. Consumption of commercial ice cream as well as home-made ice cream was particularly great on Independence Day.

Invention and Introduction of the Brine Freezer. In 1902, the brine freezer was invented, and in a few years this device revolutionized the commercial production of ice cream. The brine freezer is a mechanical freezer, operating without the use of ice. The freezing agent in this device is calcium chloride brine or some other chemical. The chemicals are used to produce a freezing temperature by the same method used in the mechanical refrigerator of today. By 1905 all manufacturers of ice cream in Nebraska used the brine freezer.

Invention and Introduction of the Homogenizer. The homogenizer, invented in 1902 in Paris, France, was generally introduced by ice cream manufacturers in Nebraska around 1907 (Fig. 1). The purpose of the homogenizer is to effect a physical change in the butterfat by breaking

[7] *Ibid.*, p. 11.
[8] Lincoln, Nebraska, April 2, 1935.

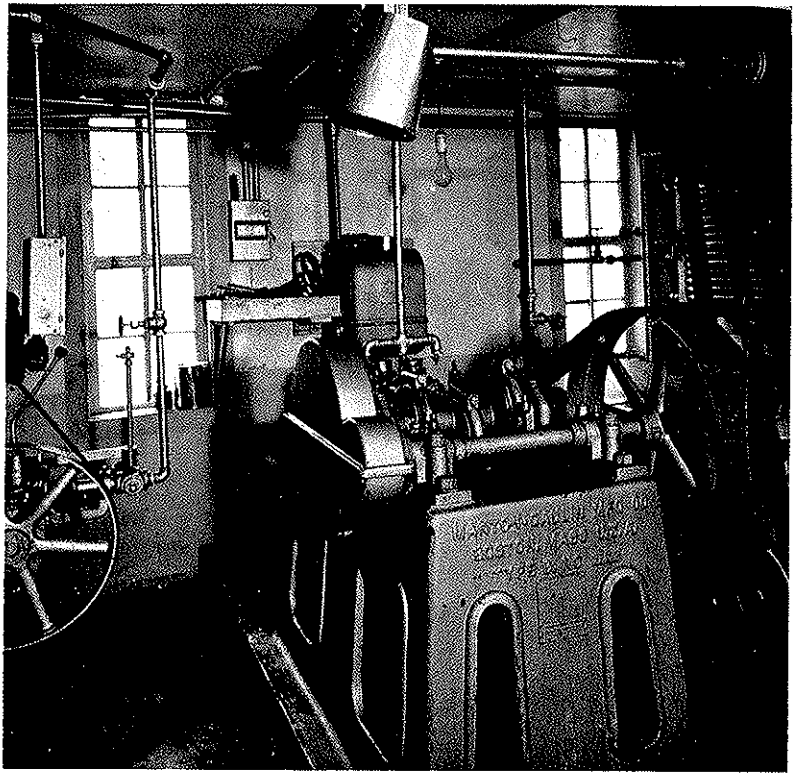

FIG. 1.—A homogenizer. This appliance effects a physical change in the butterfat by breaking fat globules into very minute sizes.

the fat globules into very minute sizes. A fat globule of 6 microns[9] in diameter upon homogenizing yields 216 minute globules 1 micron in diameter. This disintegration is accomplished by forcing the butterfat through fine apertures under a pressure ranging from 2,500 to 4000 pounds per square inch. Homogenizing is an essential operation in the production of all commercial ice cream. It serves to increase the viscosity of the mix, prevents the churning of the butterfat in the freezer, improves its whipping quality, and in general improves the body and palatability of the finished product.

Introduction of Ice Cream Cabinets. By 1907-8 ice cream cabinets were generally introduced among retailers. The filled ice cream cans were removed from the wooden tubs in which they were shipped and placed in the cabinet. Chipped ice was then packed around the cans in the cabinet.

[9] A micron represent one-thousandth part of one millimeter.

By properly repacking the ice cream at intervals, it could be preserved for several weeks. This device enabled retailers to keep ice cream in stock the year round and greater consumption was brought about.

Constituents of Commercial Ice Cream. A number of dairy products are used to produce commercial ice cream. A given amount of butterfat must be used in preparing the mix, and one or several of the following dairy products may be used: condensed milk, condensed skimmilk, dried milk, dried skimmilk powder, and skimmilk. In addition to these, varying amounts of sugar, gelatin, flavoring, and sometimes egg-yolk solids are used. Sommer suggests the following as a good average mix:[10]

Fat	12.5 per cent
Serum solids	10.0 per cent
Sugar	16.0 per cent
Gelatin	.25 to .50 per cent
Egg yolk solids	.50 per cent[10a]
Total solids	39.25 to 29.50 per cent

It will be noted that Sommer suggests 12.5 per cent butterfat for a good average mix. Commercial producers are agreed that a highly satisfactory ice cream can be made with this amount of fat. However, a statutory decree in Nebraska prohibits the manufacture and sale of ice cream with such an amount of butterfat, except in the case of fruit cream. In the latter ice cream, 12 per cent is the minimum required by law; in all other creams a minimum of 14 per cent is required.[11] Nebraska is one of the six states requiring this high percentage of butterfat in manufactured ice cream.[12]

The average mix recommended by Mr. Sommer contains 10 per cent serum solids. Many ice cream mixes contain greater percentages. The greater the amount of water replaced by serum solids in ice cream, the smoother will be the frozen product, since fewer ice crystals can form. The solids also tend to intersperse themselves between the crystals, and thus the latter become more difficult to detect.

As has been indicated, serum solids in milk consist of the non-water and non-fat constituents of milk. All non-water constituents, including fats, are spoken of as total solids in milk. More specifically the term "serum solids" refers to the casein, albumin, globulin, lactose, milk salts, and traces of other non-fatty constituents. The amount of serum solids in average skimmilk ranges from about 8 to slightly over 9 per cent. It follows that ice cream with a serum solid of 10 per cent or more must have

[10] *Op. cit.*, p. 11.

[10a] Egg yolks are not used by all manufacturers, although Sommer recommends their use.

[11] *Compiled Statutes of Nebraska*, 1929, Sections 81-903.

[12] *Legal Standards for Dairy Products*, U. S. Dept. of Agriculture, 1932.

some form of condensed powdered skimmilk added to the mix. The various Nebraska dairy plants concentrating skimmilk find that ice cream producers are among their best customers.

Sugar contributes the greatest percentage to the total solids in ice cream. The tabulation on p. 10 of the proportion of various solids indicates this clearly.

Gelatin is added to the ice cream in very modest amounts to act as a stabilizer. This means that it lends some degree of rigidity to the frozen product when exposed to slightly warmer temperatures.

Egg yolk, nearly always in a processed form, is added to the mix to improve the texture and to act as a stabilizer. The use of egg yolks, however, is not common among all ice cream manufacturers.

Besides the ingredients of ice cream mentioned, manufacturers may use nuts, fruits, and other ingredients. So many and varied are the possibilities in ice cream recipes that they cannot be discussed fully in this connection. Even the list of the more common forms of ice cream is a lengthy one. Sommer lsits the following as common forms:[13]

1. Plain
2. Nut
3. Fruit
4. Bisque
5. Mousse
6. Parafait or New York
7. Puddings
8. Custards
9. Ices
10. Sherbets

Distinguishing Characteristics of Common Forms of Ice Cream. It should not be assumed that the above list of types of ice cream is all-inclusive. Innovations of new types are so frequent and varied that such a list must always be submitted with reservations. The distinguishing characteristics of these various ice creams must therefore be stated rather broadly.

The composition of *plain ice cream* ranges within rather broad limits. The fat content of the frozen product may range from 8.0 to 16.0 per cent and even reach 22.0 per cent; the serum solids may range from 6.0 to 12.0 per cent, sugar from 12.0 to 17.0 per cent, and gelatin from 0 to 0.7 per cent. Other stabilizers such as eggs or gums may be used, the former being more common.[14] Plain ice cream is flavored with a variety of flavors, such as vanilla, chocolate, maple, mint, and butterscotch.

Nut ice cream is made from the same mixes as plain ice cream with the addition of walnuts, almonds, filberts, pistachio, and other nuts. Grape nuts are not to be regarded as a substitute for real nuts in the production of this ice cream.

---

[13] *Op. cit.*, p. 5.
[14] Sommer, *op. cit.*, p. 5.

The same mix used to prepare plain ice cream is used to prepare *fruit ice cream*. While practically all kinds of fruits have been tried in producing fruit ice cream, ices, and sherbets, some fruits find much greater favor because of taste preferences and also because of the quality the fruit imparts to the finished product. Strawberries are by far the most favored fruit in flavoring ice cream. Others that are also popular are pineapple, cherries, bananas, and oranges. Apricots, raspberries, and peaches, although producing a satisfactory product, are used infrequently. For ices and sherbets oranges and lemons are very popular.

Bisque ice cream is made from standard mixes to which such constituents as macaroons, grape nuts, cakes (dried and crumbled), marshmallows, and flavoring materials are added.

Mousse is whipped cream to which sugar, flavoring, and perhaps fruits are added before freezing. Today many different types of this ice cream are produced. Frequently mousse is merely a standard mix to which additional cream and sugar are added before it is frozen.

Parfait or New York ice cream is made from standard mix to which eggs, usually egg yolks, are added, which impart to the finished product a distinctly yellow color. Since the color of egg yolks varies, color is frequently added to the mix to obtain a uniformly colored product.

The production of *puddings* as ice cream is as yet very unstandardized. Instead of containing but one fruit, as fruit ice cream does, puddings contain a mixture of fruits.[15] Sommer suggests that, as in the case of New York or Parfait ice cream, egg yolks be added to puddings in order that they fully merit their name.[16]

The base for *custards* consists of milk, eggs, and starch. To this base, cream, sugar, and flavoring are added before the mixture is frozen. Most home-made ice creams are merely custards. This form of ice cream is rarely made commercially.

Ices contain no dairy products. Instead they are made from sweetened diluted fruit juices. In addition they may contain color, fruit flavoring, and a stabilizer. For tartness citric acid is added. Partially frozen ices are known as *frappé*. When liquor replaces the fruit juices in part or altogether in ices, the product is known as *punch*.

Sherbets are similar to ices, the only distinction being that milk, cream, or an ice cream mix is used to replace partly or wholly the use of water in diluting the fruit juices.

---

[15] *Op. cit.*, p. 7.
[16] *Idem.*

Although an infinite number of kinds of ice cream can be produced, the majority of manufacturers confine their production to the better known kinds, such as plain, fruit, and nut ice creams. In recent years sherbets have also become highly popular. Other kinds of "creams" are produced mainly by the larger ice cream manufacturers for special trade. Most retailers hesitate to hold in stock many different kinds of ice cream because of inability to maintain consistent, rapid turnover.

Preparing the Mix. Ice cream, by its very nature, caters to a refined, critical taste. It is highly essential, therefore, that only quality ingredients be used to produce a tasty frozen product. The cream used to prepare a mix should be clean, fresh-flavored, and very low in acid. Cream with no more than 0.15 per cent acid makes an excellent ingredient for ice cream. In many sections of the United States fresh cream is difficult to obtain, particularly during very warm weather, and as a result much ice cream is made from cream with an acid test of 0.23 to 0.25 per cent.

Milk to be used in the ice cream mix should also be clean flavored and low in acid. It is advisable that no milk testing above 0.20 per cent acid be used in preparing a mix, since sourness in milk can be detected more rapidly than sourness in cream.

Commercial-ice-cream producers prepare the mix in a vat equipped for pasteurization and also with a revolving agitator or mixer (Fig. 2). Both of these features are necessary. When all of the necessary ingredients have been added to the mix, it is pasteurized. The purpose of pasteurizing is to improve the keeping qualities by reducing the bacteria to a minimum, to destroy bacteria that may be inimical to the health of the consumer, and to dissolve the sugar, gelatin, and other ingredients properly. With ingredients of proper quality, a pasteurizing temperature of 145° F. for 30 minutes is considered adequate.

All commercial ice cream mixes, upon pasteurization, are promptly homogenized. After homogenization, the mix is cooled to a temperature of 30° to 40° F. on a tubular or surface cooler. Following this operation it is run into holding or aging tanks.

Aging the Mix. Aging the ice cream mix consists of holding it at a low temperature for varying lengths of time in order to improve the whipping quality of the mix as well as the body and texture of the finished product. Up to several years ago it was considered desirable to age the mix for several days and in some instances even for a week or more (Figure 3). More recently it has been found that the benefits derived from aging can be obtained in as little as four hours.[17] Some commercial producers doubt

[17] L. K. Crowe, Department of Dairy Husbandry, University of Nebraska, August 20, 1935.

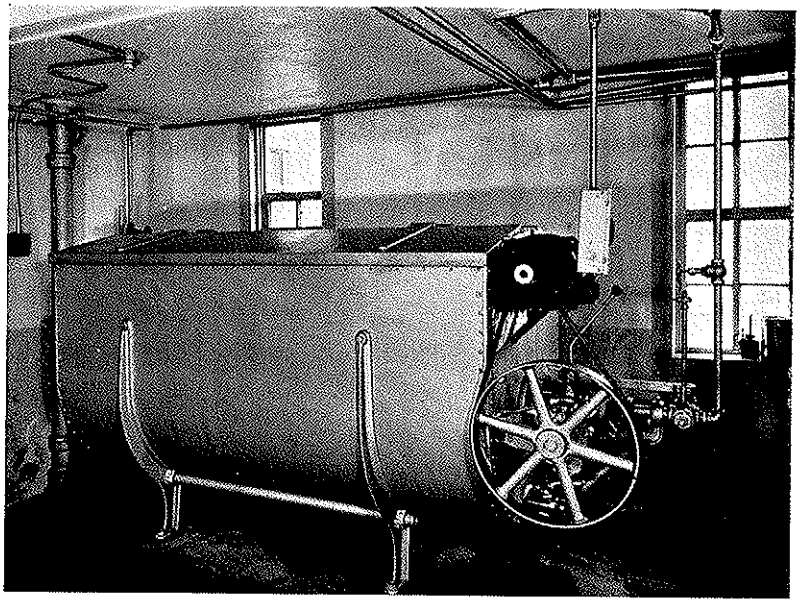

FIG. 2.—Mixer and pasteurizer of ice cream mix (Picture taken in Roberts Dairy Company plant, Lincoln).

that the practice of aging serves any good purpose and proceed to manufacture the ice cream directly. Sommer, however, states that experimental evidence does support the view that aging benefits the mix.[18]

Freezing and Whipping the Mix. The commercial freezer does not freeze the ice cream to the relatively solid forms in which we buy it but merely freezes the product partially and then whips it with the rotating dasher with which it is equipped. Whipping effects what is known as the "overrun" in ice cream. The principle of this operation is the same as that of whipping cream. A certain amount of air is incorporated with the cream, which increases its bulk and decreases its consistency. Overrun is, therefore, the difference in the volume of ice cream taken out of the freezer and the amount of the mix placed in the freezer. The amount of overrun found in different ice cream varies. Too much or too little overrun makes for undesirable qualities in the finished product. An average overrun of 80 per cent in the better ice cream is common. In the cheaper creams an overrun of 120 to 130 per cent is not uncommon.

Ice cream could be frozen without an overrun, but the product would be undesirable. It would be uncomfortably cold in the mouth as well as

[18] *Op. cit.*, p. 137.

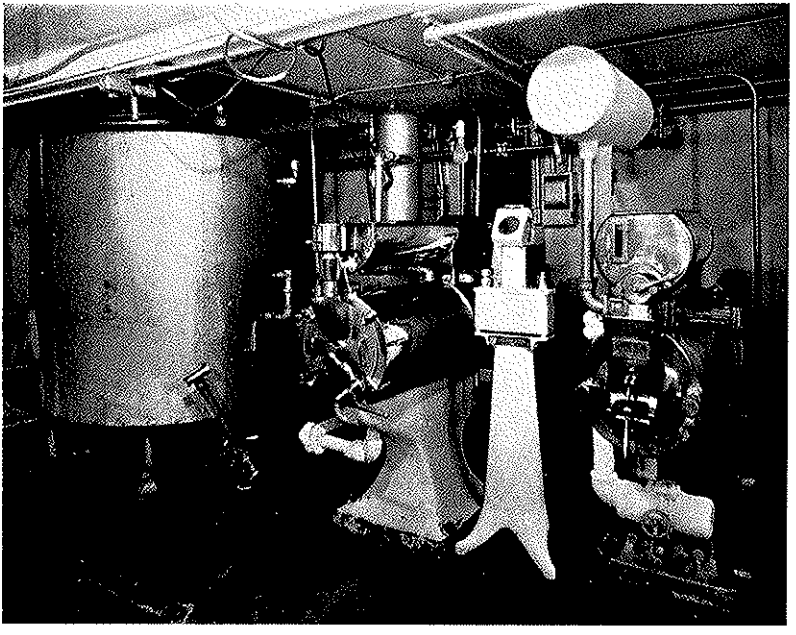

FIG. 3.—Ice cream freezers (at right) and mix aging tank (at left) (Picture taken in Roberts Dairy Company plant, Lincoln).

heavy, soggy, coarse in texture, and unpalatable. Too much air, on the other hand, produces frothy and snowy ice cream. Both extremes must be avoided.

After the ice cream is partially frozen and whipped, it is poured into the various containers in which it is to be retailed (Fig. 4). These containers, aside from the specialty forms, range in size from the small cup, pint, and quart paraffin cartons to the steel containers having a capacity of ½ to 10 gallons (Fig. 5). In these containers ice cream is placed in the hardening room where it is frozen solid in temperatures ranging from 0° to 20° F. It is then ready to be packed for marketing.

Specialty Forms of Ice Cream. Few food-producing enterprises have been subjected to as great a number of innovations with regard to specialties and "fancy forms" as has the ice cream industry. As soon as an industrious manufacturer obtains the necessary facilities to cater to one whim of the consuming public, he is almost sure to find that other specialty forms of ice cream that may become nationally popular have been patented. These rapid innovations indicate that the industry is youthful and highly competitive and also that the product is a popular one which lends itself

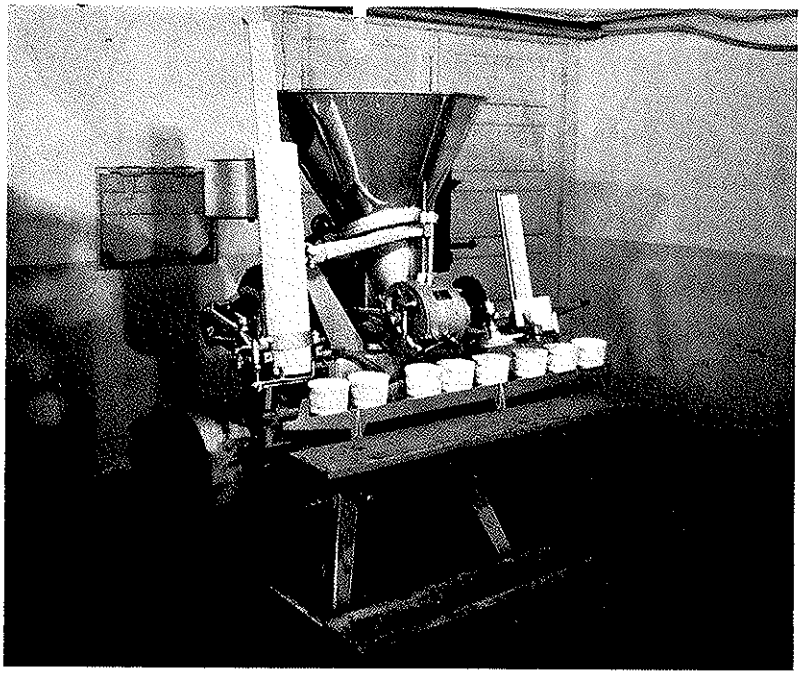

FIG. 4.—Ice cream packing machine. The device automatically fills 32 containers a minute, caps them, and also stamps the flavor and date on the package (Picture taken in Roberts Dairy Company Plant, Lincoln).

to many shapes and forms for retailing purposes. Although not all of these specialty forms of ice cream can be described in this publication, the more popular types deserve brief consideration.

Brick Ice Cream. Although all the common kinds of ice cream can be put out in brick form, this specialty is largely restricted to plain, nut, and fruit ice creams. A rather popular form is known as Neopolitan ice cream. It is composed of three layers of differently flavored and colored creams. These layers are usually flavored with vanilla, strawberry, and chocolate and have corresponding characteristic colors.

Another form of brick ice cream is known as the "center mould brick." This consists of a brick of ice cream through whose center runs a special mould such as a leaf, a plant, a fruit, a vegetable, or a bird. By color differentials this center-mould brick ice cream is rendered highly attractive and popular.

The somewhat rigid form that brick ice cream must maintain upon exposure restricts this form almost entirely to ice creams high in solids, which include such stabilizers as gelatin or egg solids or both.

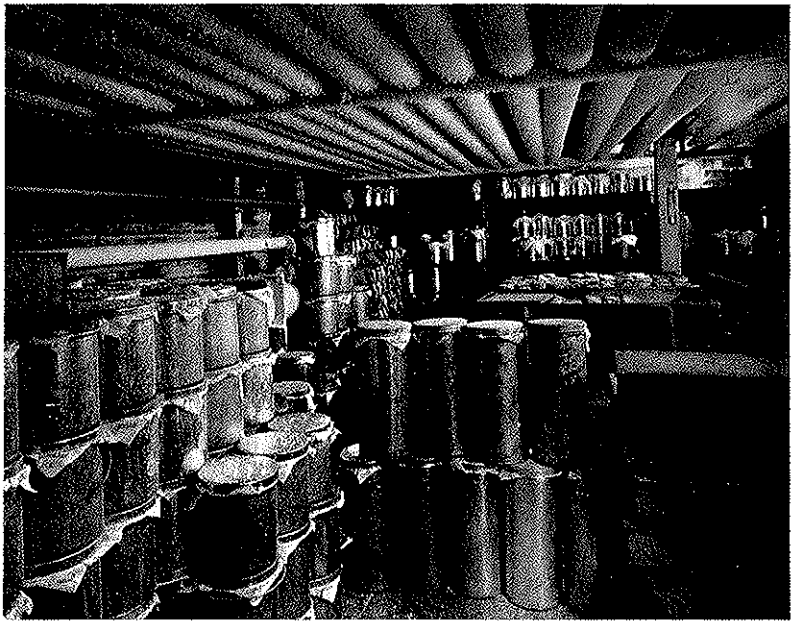

FIG. 5.—Ice cream hardening room. The temperature in the room ranges from 0 to −20° F. Notice the different sized containers (Picture taken in Roberts Dairy plant, Lincoln).

Brick ice cream only roughly approximates the shape of a brick. Its measurements should be about 2⅞ x 3¼ x 6¼ inches, which means that its contents are slightly in excess of a quart (57.75 cubic inches).

Eskimo Pies were invented in 1921 and have since become a rather popular form of ice cream specialty. They consist of slabs of ice cream that have been dipped in melted chocolate. After the cream is dipped in chocolate and the latter has hardened, the "pies" are wrapped, placed in a cooling room, and thoroughly hardened throughout. This ice cream specialty is now sold under many names.

Frozen Suckers and Popsicles are made from ice mixes and are patterned after suckers and lollypops to the extent of having a wooden stick inserted to serve as a handle. Fudgsicles, as the name implies, are made from a base of fudge to which some milk and cream are added. They are also patterned after suckers and lollypops. All of the specialties enjoy a wide sale during hot weather and are rarely held in retail stock with the advent of cooler weather.

Moulded Ice Cream. By casting ice cream into molds, likenesses of objects are produced (Fig. 6). The more common moulds with properly colored ice cream will produce various finished products, resembling fruits, vegetables, birds, animals, fraternal emblems, cakes, pies, and other objects. To attain a more or less perfect likeness some forms receive additional decorations upon being frozen. Most of the moulds are of such size as to make individual servings; others, such as cakes and pies, can be used to serve a group of people. Moulded ice cream, where available, is becoming very popular for parties, as well as for special dinners and occasions.

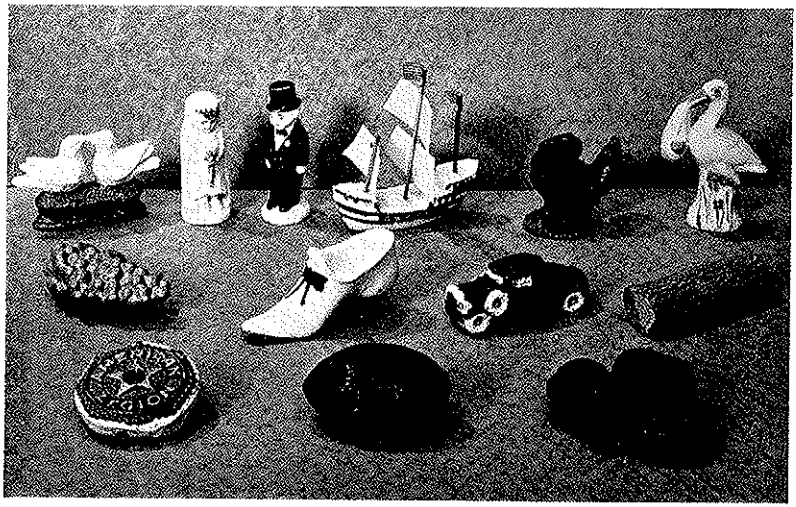

FIG. 6.—Moulded ice cream (Picture taken in Roberts Dairy Company plant, Lincoln).

To prepare *plaque ice cream,* bricks of ice cream are cut into slices and relief forms are applied on them through cut stencils. Whipped cream, properly colored, is used to fill the stencil opening and form the relief object. Stenciled ice cream or plaque ice cream can be prepared more easily than moulded ice cream; consequently it is cheaper and also more popular.

Not every ice-cream producer in Nebraska can indulge in the necessary equipment to produce all these specialty forms of ice cream. Production of some of the more fancy types requires specially trained men, and not every producer of ice cream can afford to hire such men. Thus a general relationship exists between the size and the output of a plant and the variety of ice cream forms it produces and markets. Bulk and brick ice cream, with perhaps one specialty form, are the production lines of the majority of plants.

Methods of Packing Ice Cream. Methods of packing ice cream vary. Ice cream which is shipped a considerable distance must be packed better than that which reaches its destination in a few hours. There is also a difference in packing because of the fact that some manufacturers adopt new and perhaps more convenient forms of packing the product, while others, because of a large investment, retain older methods.

Until a few years ago the common method of packing ice cream was the *tub method.* By this method the ice cream in a steel container was placed in a large wooden tub and the intermediate space filled with chipped or ground ice with an admixture of salt. A strong canvas top was then placed over the top of the tub and tied in place. In this manner the bulk ice cream was retailed and wholesaled. Improved methods have simplified the packing of this product. Since most ice cream is sold and shipped in summer, the melting of the packing ice in the tub necessitates repacking at intervals. The frequency and nature of this work makes it an unpleasant task. The weight of the tub and the ice make handling difficult and serves to increase the transportation cost.

At present the ice-cream tub has been replaced to a large extent by *felt bags.* These bags are smaller and lighter than the wooden tubs and have unusual insulating qualities. Ice is never used in packing and shipping ice cream in felt bags. If the ice cream is shipped a short distance and is in transit only a few hours, a can of ice cream may be placed in one of these cool felt bags and without addition of any cooling agent sent on its way. Upon arriving at its destination the can should be removed and placed in a cooling or ice-cream cabinet.

Ice cream that will be in transit for more than a few hours and is shipped in felt bags must be packed with some cooling agent. For this purpose *dry ice* has become very popular. It is a solid, compact, and frozen form of liquid carbon dioxide, which freezes at a temperature of -114° F. and therefore has a much greater refrigeration value than water ice. Properly insulated, a few small slabs of this ice will provide refrigeration for ice cream for a considerable time. The weight of such slabs of dry ice is negligible and transportation cost is kept at a minimum. Dry ice vaporizes as fast as it melts; hence it leaves no accumulated water.

Calcium chloride cartridges are elongated, triangular-shaped steel containers in which is found a patented freezing liquid. These cartridges are placed in the ice-cream freezing room or compartment, where the liquid in the containers freezes solid. In the cold state the cartridges are placed in felt bags next to packed ice cream and serve to retain a low temperature for varying periods of time, depending largely on the prevailing weather.

The size and weight of the calcium chloride cartridges restrict their use largely to local trade. Shipping ice cream long distances with these freezing units increases freight charges.

Ice cream kept by retailers is stored in various ways. A few retailers still have the old ice cabinets which must be repacked at intervals. Most retailers of ice cream now have mechanical refrigerators. These may be owned outright or may be rented from ice cream manufacturers. The constant temperature which the mechanical refrigerator maintains with little or no attention makes it very popular. A few retailers keep ice cream by the Waltham Cartridge method. This method necessitates regular servicing or replacement of cartridges by the ice cream manufacturer.

Wholesaling Ice Cream Mix. Ice cream manufacturers may be divided into two groups, viz., (1) those that prepare and freeze the mix and sell the ice cream and (2) those that purchase the prepared mix, freeze it and sell the ice cream. A considerable business has been developed by some plants in preparing mix for smaller ice cream producing plants. A number of factors have given rise to this new adaptation of the industry. An ice cream plant or shop may be located in a place where no constant and adequate supply of fresh cream is available. Hence it may be advisable to purchase a prepared mix from a plant located in a region where dairying is more common. This condition prevails to some extent in Nebraska. Some manufacturers of ice cream in western Nebraska obtain a commercial mix from plants in eastern Nebraska where more cows are milked regularly. Certain manufacturers of ice cream, because of limited output, cannot profitably maintain all the necessary equipment to prepare and store an ice cream mix. Accorling to Mr. R. W. McGinnis, secretary of the Nebraska Association of Ice Cream Manufacturers, an ice cream producer selling less than 10,000 gallons of ice cream a year cannot afford to invest money in equipment required to prepare ice cream mix.[19] Even if some producers wish to take exception to Mr. McGinnis' figure, which serves to divde the complete plant from the partial plant, the proposition seems tenable that with restricted output a complete plant cannot be maintained profitably. With good ice cream mix available at a reasonable price, many smaller plants find operation profitable.

The recent innovation of counter freezers by food shops and drugstores has created an additional outlet for prepared mix. With a prepared mix as a base, each small producer of ice cream can prepare a great variety of special ice creams. In general, the sale of ice cream mix seems to be increasing.

Frozen Cream. The scarcity of sweet cream during certain seasons of the year in some parts of Nebraska makes storage of fresh quality cream profitable. Cream of a certain quality, properly processed, may be stored as frozen cream. Cream to be frozen must be properly handled from the

[19] Lincoln, Nebraska, May 1, 1935.

very first. It must come in contact only with clean utensils. The separator must be washed after each operation. The cream must be chilled promptly and marketed the same day. At the plant it is tested for butterfat, acidity, and off flavors. Cream with a considerable amount of acidity is rejected. The accepted cream is re-separated to concentrate the butterfat. It is then pasteurized, homogenized, and frozen. Properly handled and stored, it is an excellent cream for making ice cream or for other food uses.

The amount of cream frozen in Nebraska is small. Nearly all frozen cream is sold to the more profitable markets in the East. Where the current supply of fresh cream for use in ice cream production is inadequate, the use of reconstructed cream is more popular. The practice of reconstructing cream from butter, which strikes most people as somewhat curious, deserves a word of explanation and defense.

Reconstructed Cream. The ice cream producer aims to get a certain amount of butterfat into the ice cream he produces because of the qualities which it imparts to the frozen product. It matters little whether the butterfat is obtained directly from cream or from butter. The nature and the amount of the fat remain the same. The use of reconstructed cream offers the producer of ice cream a simple method of storing butterfat during the season of surplus cream for seasons in which it is scarce. Certain ice cream producers also believe that the reconstruction cream is less likely to be marked by certain off flavors which may have been in the fresh cream from which the butter was made. In certain sections of the state where fresh cream is difficult to obtain and where weed flavors in cream are common, the practice of producing ice cream from reconstructed cream is not uncommon.

Reconstructed cream is made from a good grade of unsalted sweet-cream butter, which is thoroughly worked. In case such butter is kept, it is stored at a temperature of 0 to −10° F. "Reconstruction" of cream consists of mixing butter with sweet, fresh skimmilk, and passing the mixture through an emulsifier at pasteurizing temperature. So perfect is reconstructed cream in body and taste that it is not easily distinguished from fresh cream. Only a small percentage of the ice cream produced in Nebraska is made from reconstructed cream.

Nebraska's Statutory Requirement of Butterfat Content in Ice Cream. The statutory requirements of minimum butterfat content in ice cream varies from 8 to 14 per cent in the various states. Nebraska is one of six states requiring a minimum butterfat content of 14 per cent in non-fruit ice cream.[20] States bordering Nebraska have the following requirements:

[20] The other states requiring an equal butterfat content in ice cream are Maine, Nevada, New Hampshire, Utah, and Vermont (1935).

South Dakota and Iowa, 12 per cent; Kansas, Colorado, and Wyoming, 10 per cent; Missouri, 8 per cent.[21] Students of the dairy industry of this state as well as ice cream manufacturers agree that Nebraska may well lower the statutory requirements of butterfat content in ice cream to a point that more nearly equals the requirements obtaining in neighboring states. This change is desirable for a number of reasons. Ice cream with a moderately lower butterfat content would still be highly palatable. As a matter of fact, most consumers would not be able to detect a difference in properly prepared cream containing from 2 to 4 per cent less butterfat.

Lower butterfat ice creams would also be less fattening, more easily digested, lower in cost, and would largely prevent the bootlegging of cheaper ice cream across the Nebraska border. A less fattening form of ice cream would appeal to persons apprehensive of gaining weight as well as to those interested in becoming slender. Moreover, it appears somewhat paradoxical that a food consumed most generously in hot weather, should, according to statutory decree, be high in fat content. The requirement may well be lowered, although a definite standard should be maintained.

Lowering the statutory requirement of butterfat in ice cream does not necessarily mean that all manufacturers would lower the butterfat content to the lowest required point. At present, for instance, some producers catering to special tastes prepare mixes with 18 per cent butterfat. This privilege as well as practice would continue under lower basic butterfat requirements in ice cream.

Production of Commercial Ice Cream in Nebraska. No figures are available on the amount of ice cream produced in Nebraska prior to 1920. It is generally agreed that production and consumption of ice cream increased very materially during the period of the World War. In the absence of figures we do not know how pronounced this increase was. From 1920 to 1924 production of ice cream remained relatively constant (Table 1). From 1925 to 1929 production increased from about 2,000,000 to slightly over 3,000,000 gallons. Since 1929 the production by commercial producers has been cut in half (Table 1). This pronounced decline in commercial production is traceable to the effect of the economic depression, and, in part, to the more widespread use of mechanical refrigerators in the home.

Table 1 also shows the number of wholesale and retail establisments manufacturing ice cream. It will be noted that the number of manufacturers wholesaling ice cream increased from 78 in 1921 to 89 in 1936, while the number of manufacturing establishments retailing ice cream increased from 68 to 242. It is of interest that the number of manufacturing establishments retailing ice cream increased most rapidly since 1931, when

[21] *Legal Standards for Dairy Products, op. cit.*

TABLE 1.—*Commercial Production of Ice Cream in Nebraska, 1921-36.*

Year	Gallons [1]	Number of Licenses Issued [2]		
		Wholesale	Retail	Total
1921	1,949,000	78	68	146
1922	1,986,000	89	67	156
1923	2,042,000	..	..	...
1924	2,052,000	.	..	...
1925	2,369,000	67	47	114
1926	2,476,000	64	49	113
1927	2,536,000	67	37	104
1928	2,816,000	66	42	108
1929	3,051,000	63	40	103
1930	2,938,000	75	55	130
1931	3,289,000	82	94	176
1932	1,581,000	102	138	240
1933	1,488,000	97	190	287
1934	1,872,000	84	183	267
1935	2,023,000	87	209	296
1936		89	242	331

[1] Figures for 1921 to 1929 from *Nebraska Agricultural Statistics, 1930*, U. S. Dept. of Agriculture and Nebraska Dept. of Agriculture; for 1930 to 1936 from Department of Agriculture and Inspection, Lincoln.

[2] From Department of Agriculture and Inspection, Lincoln.

production and consumption declined at an alarming rate. In part, this increase represents the installation of numerous counter-freezers, particularly in the last two years, and in part it reflects the erection of new plants. The perfection of small freezing units has played a part in this development.

Prospects and Tendencies in Ice-Cream Production. Ice cream is a favored food in the diet of Americans. It possesses qualities that make it extremely tasty; it is highly nourishing; and it may be prepared in ways that render it most attractive to the eye. A food promoter could hardly ask for more.

The main ingredients from which this food must continue to be prepared are supplied by the dairyman. A generous consumption of ice cream, therefore, plays an important part in making the milk cow pay. To the dairyman it matters little whether this delicacy and nourishing food is prepared in the home or in the factory. The demand for milk and cream will remain the same.

It is reasonable to believe that the commercial ice-cream producer will continue to supply the greater share of ice cream. With costly facilities at his disposal, he can consistently produce a frozen product that is superior in many respects to the ice cream produced in the home. It is also true that housewives prefer to purchase as many ready-made foods as possible, as is shown by the wide-spread practice of purchasing canned and baked goods.

It is likely that the commercial producer of ice cream will find it necessary to market a greater per cent of his product in various specialty forms. A greater variety of flavors and forms of ice cream may have to be offered for sale. Sherbet flavors may have to be made a general stock-in-trade. Ice cream in cups and bars with various flavors already finds a profitable outlet. The manufacture of such specialty forms serves to increase the cost of production but also serves to sustain the market outlet.

Severe competition within the industry will serve to maintain the prices of such specialties as well as of stable ice cream at a minimum—at times and in places at distressingly low minimums. Low cost and a varied production program, on the other hand, assures the consumers low-priced products of a varied and attractive nature. Economic conditions permitting, the consumption trend of ice cream in its many forms should be upward.

Summary

Reports have it that the illustrious Marco Polo in the 14th century learned from the Japanese the making of water ices and milk ices, and that he carried this information back to Europe. The Europeans knew how to make water ices in 1550, and milk and cream were added to such mixtures. The secret of making ice cream was brought to this country by the early immigrants. The first person to wholesale ice cream in the United States was Jacob Fussell, a dairyman in New York County, Pennsylvania.

Important inventions that preceded the present day development of the ice cream industry are the centrifugal separator, the Babcock test, mechanical refrigeration, the homogenizer, and speedy methods of transportation. Ice cream was made on rare occasions in Nebraska homes as early as conditions became somewhat settled among the early pioneers. It continued to be regarded as a rare delicacy and was produced sparingly practically up to the period of the World War.

Prior to the advent of the electrical refrigerator for the kitchen, housewives made ice cream by the "syrup-bucket method" or by the hand-freezer method. The latter method is still popular. Agitation in some form is desirable during the freezing of the mix, as it assures a more uniformly frozen product and also serves to incorporate air into the mix, rendering it lighter and more palatable. The greater the water content of an ice cream mix the less smooth is the resultant frozen product, because water upon freezing forms into crystals of varying sizes.

Nebraska had only three wholesaling ice cream plants in 1900. The absence of ice cream cabinets prior to 1907-8 made ice cream highly perishable. For this reason it was the general practice among retailers to obtain and sell ice cream only on week-ends and for special holidays occurring in summer.

Although a great variety of ice creams can be produced, the majority of manufacturers confine their production to the better known kinds, such as plain, fruit, and nut ice creams. In recent years sherbets have become highly popular. Few food producing enterprises have been subjected to as great a number of innovations with regard to specialties and "fancy forms" as has the ice cream industry. Not every ice cream producer in Nebraska can invest in the necessary equipment to produce all the specialty forms of ice cream. A considerable business has been developed in recent years by some plants in preparing mix for smaller ice cream producing plants. It matters little whether the butterfat used in the production of ice cream is obtained directly from cream or from butter.

From 1925 to 1929 the production of commercial ice cream in Nebraska increased from about 2,000,000 to slightly over 3,000,000 gallons. From 1929 to 1933 the production by commercial producers has been reduced to about one-half. The pronounced decline in commercial production of ice cream in Nebraska in recent years is traceable to the effects of the economic depression, and, in part, to a more widespread use of the mechanical refrigerator in the home. The number of manufacturers wholesaling ice cream increased from 78 in 1921 to 89 in 1936, while the number of manufacturing establishments retailing ice cream increased from 68 to 242 during the same period. It is reasonable to believe that the commercial ice cream producer will continue to supply the greater share of the ice cream consumed.

A statutory decree in Nebraska requires that commercial fruit ice cream must contain 12 per cent butterfat and other commercial ice cream 14 per cent. Students of the dairy industry of this state as well as ice cream manufacturers agree that Nebraska may well lower the statutory requirements of butterfat in ice cream to a point that more nearly equals the requirements obtaining in neighboring states.

The commercial producer of ice cream finds it necessary to market a greater per cent of his product in various specialty forms. Although the production of specialty forms of ice cream serves to increase the cost of production, it also serves to sustain the market outlet. Economic conditions permitting, the consumption trend of ice cream in its many forms should be upward.

Acknowledgments

The writer is especially indebted to the following people for assistance given during the preparation of this report: Mr. A. L. Haecker, Chief of the Bureau of Dairies, Foods, and Drugs; Dr. G. E. Condra, Dean and Director of the Conservation and Survey Division of the University of Nebraska; Mr. Lawrence Crowe of the Dairy Husbandry Department of the University of Nebraska; Mr. Fred Caldwell of the Franklin Ice Cream Company, Lincoln; Mr. R. W. McGinnis, secretary of the Nebraska Association of Ice Cream Manufacturers (1935); and Mr. Richard Hufnagle, who took the photographs. The late Dr. J. T. Link, Mr. E. C. Reed, Miss Grace Owens, and my sister, Johanna Kollmorgen, have read the manuscript and offered valuable suggestions.