STUDIES ON FLAVOR, BODY, TEXTURE AND WHIPPABILITY OF MALTED MILK DRINKS

By

ROBERTHA CLACK MATTESON

Bachelor of Science

Kansas State College

Manhattan, Kansas

1940

Submitted to the Department of Household Science

Oklahoma Agricultural and Mechanical College

In Partial Fulfillment of the Requirements

for the Degree of

Master of Science

1946

APPROVED BY:

Chairman, Thesis Committee

Member of the Thesis Committee

Head of the Department

Dean of the Graduate School

STUDIES ON FLAVOR, BODY, TEXTURE AND WHIPPABILITY OF MALTED MILK DRINKS

ACKNOWLEDGEMENT

The writer wishes to express her appreciation to Dr. H. C. Olson for his assistance and direction of the work reported, and to members of the Household Science Department for the time expended in the preparation of this paper.

TABLE OF CONTENTS

PREFACE

There is little in the literature on the factors that determine or influence the quality of malted milks or milk shakes. Therefore, the object of this research was to study some of the factors that are related to the production of a better malted milk drink, special emphasis being given to the development of a new flavor.

Malted milk drinks and milk shakes are so popular with the American public that they are served in almost every place where ice cream is sold. Basically, all malted milks are the same. Malted milk is made by whipping together milk, ice cream and flavoring material. The flavoring material may be chocolate syrup or any other of the many flavorings available. On the other hand, there is little uniformity from one selling place to another in the procedure used in making of milk shakes. The ingredients in the ice cream, the amount of ice cream, the amount of milk, whipping time and the amount and kind of flavoring influence the body, texture and flavor of the finished drink.

There are many flavoring materials on the market and the possible combinations from them are limitless. Many of these flavors are distinctive in their character, but would appeal to few people or would do for occasional use only. In the ice cream industry, it is noted that vanilla is by far the most favored flavor, with chocolate running a poor second. Far down on the list are the other special flavors. The spice flavors such as cinnamon and nutmeg are only popular in the baking industry. The flavor of butter and coffee are two that are accepted daily by a great many people and seemed worthy of consideration.

REVIEW OF LITERATURE

Chocolate and vanilla have been used in preparing drinks on this continent for a longer period of time than is generally realized. According to Baer[1] the Aztec Indians were drinking a chocolate and vanilla concoction when the Spaniards came to America. He reported that the vanilla bean was obtained from them and grown in other parts of the world. It seemed to thrive best in the Bourbon Islands off the southeast coast of Africa. These islands include Madagascar, Reunion, Mautritius and the Seycheles. From this region, he said, come the finest vanillas in the world, but according to Lucas and Merrill[2] extracts from Mexican vanilla beans have the finest flavor in ice cream. The Mexican vanilla beans cost more than the vanilla beans from other sources because the Mexican labor cost is high and the total crop is smaller. Sommer[3] said, "There is little to choose between Mexican and Bourbon beans."

It has been reported[4] that the first vanilla flavoring was made by chopping the beans and adding them to the food. Later it was discovered that the flavor could be extracted with alcohol and the fiberous part of the bean discarded. Extraction made with thirty per cent

---

1 Samuel H. Baer, "Vanilla Beans and Vanilla Extract," Ice Cream Review, 17 (March, 1934), 32-4.

2 P. S. Lucas and A. C. Merrill, "Vanilla Flavors Do Not Freeze Out of Ice Cream," Michigan Agriculture Experiment Station Quarterly Bulletin, 11 (1929), 118-20.

3 Hugo H. Sommer, The Theory and Practice of Ice Cream Making, pp. 448.

4 Anonymous, "Use of Vanilla and Other Flavors in Ice Cream," Ice Cream Review, 26 (February, 1941), 14.

alcohol was found to be the most effective for liberating the vanillin, which is the most important flavoring constituent in the bean.

Baer[5] reported that the United States standard vanilla is made with ten grams of vanilla beans for each hundred cubic centimeter of the extract. Although vanillin is considered an adulterant by the government, the use of seven-tenths of one per cent of vanillin per gallon of extract was recommended. It was stated that most vanillin comes from oil of clove, since it is more easily freed from the clove than from the vanilla bean.

Ordinarily four ounces of vanilla extract is the amount used per ten gallons of finished ice cream. It has been said[6] that a flavoring consisting of half vanilla and half vanillin rated the highest when used in ice cream and compared with pure vanilla extract.

There is a difference of opinion on the use of vanilla in chocolate ice cream. One published article[7] said, "The use of vanilla flavor as a measure of intensifying other flavors is recommended." Fabricius[8] said, "Any improvement in chocolate ice cream by the use of vanilla extract was not evident enough to justify the added expense."

A subject of much discussion has been whether or not vanilla freezes out. Totman[9] asked the opinion of six college men and ten

---

5 Baer, loc. cit.

6 Anonymous, "Testing Consumer Preferences with Special Reference to Constituents of Ice Cream," Ice Cream Review, 28 (January, 1945), 32.

7 Anonymous, "Use of Vanilla and Other Flavors in Ice Cream," Ice Cream Review, 26 (February, 1941), 14.

8 N. E. Fabricius, "Improving Chocolate Ice Cream," Ice Cream Review, 14 (August, 1930), 72.

9 C. C. Totman, "Vanilla and Vanillin Compounds," Ice Cream Review, 14 (June, 1931), 49.

manufacturers on this matter. Five of the manufacturers and three of the college men said it did not freeze out. One manufacturer and three college men admitted they did not know, while four manufacturers said it did freeze out. Button[10] worked on the factors affecting the quality of vanilla ice cream and said that if there was a decrease in the vanilla flavor, it occurred in the first few days of storage after freezing. He suggested that vanilla was less volatile at low temperatures. Lucas and Merrill[11] made ice cream mixes that were identical except for the vanilla. They used vanilla extract from Mexican, Bourbon and Tonka beans, with and without vanillin and coumarin. These ice creams were frozen and stored at a temperature of -10 F. The ice creams were sampled at intervals up to three months and compared with freshly made samples of the same formula. The authors report, "No diminution in flavor strength after storage was detected."

The shortage of chocolate during World War II led to research on stretching the available chocolate supply. It has been reported[12] that although three per cent cocoa in prewar mixes was commonly used, two per cent cocoa in the mix made a "fairly satisfactory" ice cream. From the same source we have the following statement: "We, as yet, have not found any so called 'chocolate stretchers! .....both ice cream manufacturers and soda fountain operators would be very wise in keeping up the quality of chocolate products and do with a lesser amount rather than give the public an inferior product."

---

[10] F. C. Button, "Important Factors Affecting Quality of Vanilla Ice Cream," Ice Cream Review, 16 (March, 1933), 24.

[11] P. S. Lucas and A. C. Merrill, loc. cit.

[12] Anonymous, "To Stretch or Not to Stretch Our Available Chocolate to Meet Public Demand," Ice Cream Review, 26 (May, 1943), 224.

It is a well-known fact that the stabilizers in the ice cream used for making malted milks also affect the acceptability of the malted milk and milk shakes made from them. Stebnitz and Sommer[13] reported the functions of stabilizers in ice cream as follows: to produce a smooth body and texture in the ice cream; to prevent coarseness upon storage; and to be unperceptible to the taste when eaten. According to these same investigators, stabilizers may come from animal or vegetable sources. Gelatin is from an animal source and was one of the first stabilizers used in ice cream. The stabilizers from plant sources are starches and gum.

Stebnitz and Sommer,[14] Caulfield and Martin,[15] Gould and Lucas,[16] and Josephson and Dahle[17] all agreed that some gum stabilizers "whey off." Caulfield and Martin[18] worked with five gum stabilizers; Krabyn, HyGell, Col-Ace, Sure-Bet and Kelco Gel. They found Sure-Bet suitable for sherbets and ices, while the Kelco Gel was too hard to incorporate and gave "off flavor." Caulfield and Martin[19] found that these two cost more than the others and were not included in the final experi-

---

[13] V. C. Stebnitz and H. H. Sommer, "What Should Ice Cream Stabilizers Do," Ice Cream Review, 20 (March, 1937), 51.

[14] Ibid., pp. 51.

[15] Caulfield and Martin, "The Use of Vegetable Stabilizers in Ice Cream," Jr. of Dairy Science, 16 (1933), 265.

[16] I. A. Gould and P. S. Lucas, "A Study of Factors Influencing the Separation of Whey in Ice Cream Mixes Containing Vegetable Stabilizers," Jr. of Dairy Science, 18 (1935), 307.

[17] Donald Josephson and Chester Dahle, "A New Cellulose Gum Stabilizer for Ice Cream," Ice Cream Review, 28 (June, 1945), 32.

[18] Caulfield and Martin, loc. cit.

[19] Ibid., loc. cit.

ments. The ice creams were scored from the hardening room, from the dealer's cabinet and after heat shock. The average of these three scores for the ice creams was 22.58 for the one made with gelatin, 22.86 for the one made with Krabyn, 22.30 for HyGell and 22.70 for the Col-Ace. These investigators said, "There was virtually no difference in the quality of the finished ice cream stabilized with the vegetable stabilizer used in this study as compared with that stabilized with gelatin."

Gould and Lucas[20] further investigated "whey ing off" of ice creams made with gum stabilizers. They picked the one that gave the greatest "whey off" for their work. Gould and Lucas[21] reported that, "The principal factor involved in the whey separation is concerned chiefly with the milk products used in the mix rather than the stabilizer. The elimination of the separation of whey by any practical plant method does not appear feasible."

Prescott, Heifetz and Stanley[22] reported that the gum stabilizers, Krabyn and Tragon, left an unmeltable residue when used in ice cream. Ice cream was made with these two gums as stabilizers and scored against ice cream made with gelatin. On melting, the ice cream made with gelatin passed through a one-third inch mesh screening, but the ice creams made with the gums left a residue that would not pass through the screen. One hundred persons scored the ice cream and eighty-one preferred the

---

[20] Gould and Lucas, loc. cit.

[21] Ibid., loc. cit.

[22] Samuel Prescott, Arthur Heifetz and David Stanley, Jr., "Ice Cream Stabilizers," Ice Cream Review, 16 (September, 1932), 34-5.

ice cream made with gelatin. Eight expert ice cream judges scored the ice cream and said they preferred the gelatin stabilized ice cream in each case.

Josephson and Dahle[23] described the properties of a new gum stabilizer of high viscosity sodium carboxymethocellulose. It is a white granular powder devoid of taste and odor and does not make ice cream mix "whey off." Only fifteen to twenty hundreths per cent of this gum was necessary to stabilize a mix. Pasteurization did not affect its usefulness. The texture of the ice cream made from it compared favorably with that of ice cream made with gelatin and egg yolk. The whipping time was even shorter than that for gelatin. It was concluded that this gum stabilizer was superior to gelatin as an ice cream stabilizer.

Stebnitz and Sommer[24] proposed the use of a sodium alginate as a stabilizer for ice cream mix. This stabilizer, now on the market as Dariloid, must be combined with either sugar or water before being added to the mix. The mix should be at a temperature of 160° F. when the stabilizer is added. There was no "whey off" with this stabilizer and no change in the viscosity of the mix with aging as is the case with gelatin. It was reported that a little over half as much sodium alginate, Dariloid, as gelatin would stabilize a mix.

The effect of the temperature of the ingredients used in making the malted milk upon the desirability of the finished product was tested

---

[23] Josephson and Dahle, loc. cit.

[24] Stebnitz and Sommer, loc. cit.

by the Hamilton Beach Company.[25] For making a light or thin malted milk, it was recommended that the ingredients should be one No. 20 dip of ice cream at 10° F., eight ounces of milk at 30° F., one and a half ounces of chocolate syrup and a half ounce of malted milk powder at room temperature. This combination was then placed in a chilled container and mixed for forty-five seconds. From this study it should be noted that the whipping time depends upon the time required to break down the ice cream and obtain a homogenous mix without lumps. It was found necessary to aerate the mix to the maximum during this whipping period. The final temperature of the drink, whipped forty-five seconds, was 32° F. and the volume was sixteen and a half ounces. The texture was creamy and thoroughly aerated. Further investigations[26] were made regarding whipping time required for making a thick or heavy malted milk. The proportions used were four No. 20 dips of ice cream at 14° F., three ounces of milk at 70° F., one and a half ounces of chocolate syrup and a half ounce of malted milk powder at room temperature. This was placed in a container at room temperature and whipped. Whipping times of thirty, sixty, ninety, one hundred and twenty, and one hundred and fifty seconds were used. The best malted milk was obtained from the mix beaten for ninety seconds. The volume of this drink was thirteen ounces and the final temperature was 32° F. Whipping times above or below ninety seconds gave smaller volumes of malted milks.

Henderson[27] pointed out that "milk can hold approximately 90 per

---

[25] Anonymous, "Temperature Control in Making a Malted Milk," Ice Cream Review, 21 (June, 1938), 40-1.

[26] Ibid., loc. cit.

[27] C. E. Henderson, "Chocolate Malteds," Ice Cream Review, 24 (January, 1941), 31.

cent air when whipped at 32° F.," but will hold only twenty per cent air when whipped at 72° F. In this study it was noticed that with "chocolate malteds" a temperature around freezing gave the best results in the finished drink. Henderson[28] reported that, "Chocolate malted

> milk should be the first concern of soda fountain operators because they are much the most popular of the drinks containing milk and ice cream.....a group which outsells other fountain drinks except the low priced colas."

Powdered ice cream mixes used during World War II to supply overseas forces[29] were criticized by the service men because of the oxidized flavor found in most of them.[30]

The International Association of Ice Cream Dealers made a survey analysis[31] in 1931 on the popularity of various flavors of ice cream in the United States. Of all the ice cream sold in the United States 48.46 per cent was vanilla, 16.78 per cent chocolate, 8.27 per cent strawberry, 2.27 per cent peach, with even smaller amounts for cherry, maple, pineapple, black walnut, banana and a number of other special flavors. Since 1925 the per cent of chocolate ice cream sold had increased while the per cent of vanilla ice cream sold had decreased.

---

[28] Henderson, loc. cit.

[29] Anonymous, "Powdered Ice Cream Mix," Ice Cream Review, 29 (September, 1945), 38.

[30] P. H. Tracy, "Powdered Whole Milk and Mix," Ice Cream Trade Journal, 41, No. 4 (April, 1945), 22.

[31] Anonymous, "Survey Analyses Flavor Popularity, Type of Ice Cream Outlets," Ice Cream Review, 16 (May, 1933), 40.

METHODS

A simulated malted milk drink was used for testing the flavors. This eliminated the weighing and measuring of ice cream used in the drink and gave very nearly the same flavor as a real malted milk.

The simulated drink was made by using the same ingredients in the proportions of a real malted milk. Only the treatment was different. The simulated drink was made from whole milk powder, Plenty Powder #2[1] (a stabilizer and sugar), dextrose, sucrose, cocoa,[2] malted milk powder,[3] water and milk in the following proportions:

Table I

Simulated Drink Formula

Ingredient	Grams	Per Cent
Whole Milk Powder	23.4	7.6721
Plenty Powder #2	17.6	5.7705
Dextrose	21.7	7.1111
Sucrose	19.0	6.2295
Cocoa	5.0	1.7705
Malted Milk	2.8	0.9181
Water	95.1	31.1803
Milk	120.0	39.3442
Total	305.0	99.9963

All the dry ingredients except the malted milk powder were mixed together and added to the water. This mixture was then pasteurized at 180° F. for five minutes in a hot water bath. The hot solution was homogenized, using a hand homogenizer. The malted milk powder and milk

---

[1] Malt-A-Plenty Company, Tulsa, Oklahoma.

[2] Van Houten and Zoon, New York, N. Y.

[3] Carnation Company, Oconomowoc, Wisconsin.

were added after it had cooled to 60° F. Thirty cubic centimeter portions of this mixture were used in the flavor experiments.

The flavors were checked using the method recommended by E. C. Crocker[4] in his book, "Flavor," on pages 130 to 131. He sets up six rules for scoring dairy products. They are:

"1. Have the liquid products at a temperature of about 90° F.

"2. Concentrate on tasting. Do not think or talk of other things. Since flavors are often delicate and the senses are also delicate, this careful concentration is essential.

"3. Do not swallow the product. Roll it around slowly in the mouth until the flavor is entirely absorbed by the taste senses (concentrating all the time). Then spit it out. If this procedure is followed, the first taste will be imparted when the product is first put in the mouth; a second taste while it is being rolled in the mouth; and an aftertaste after it is spit out. These successive tastes must be compared with the ideal you have in mind for the particular product being tasted.

"4. Be sure the mouth is rinsed out well with lukewarm water before proceeding to the next sample.

"5. Do not taste too rapidly. If the mouth becomes chilled or too busy in tasting, the sense of taste is lost.

"6. Do not taste for flavor, body and texture at the same time. Taste first for flavor, and then a second time for body and texture."

The technique used in this experiment for determining the desirability of the odor was proposed by Crocker.[5] "Smelling is done best by

---

[4] E. C. Crocker, "Flavors," pp. 130-131.

[5] Ibid., Op. cit., pp. 87-92.

inhaling strongly through the nose for a period of two or three seconds with both nostrils open, even though only one is used.....As far as possible, smelling should be done far away from the hands to avoid ever-present skin odors from interfering with judgment.

"Smelling is more accurate when one specimen is compared with a standard.....It is best practice to smell first with the specimen and then the standard, several times in a five second interval....."

EXPERIMENTAL PROCEDURE

Desirability of Certain Flavors and Combinations

Random Selection

A large group of essential oils and other flavoring materials were obtained from various sources to be used in developing the new flavor. They included mint, cola, imitation rum and butter, imitation butter, oil of sweet marjoram, two lime oils, imitation licorice, imitation loganberry, imitation black walnut, anethol, imitation butterscotch, oil cognac, three butter flavors, imitation maple, imitation strawberry, imitation quince, three orange oils, root beer, oil of nutmeg, imitation peach, imitation cocoanut, oil of peppermint, imitation cassia oil (cinnamon), three Bourbon vanillas, raspberry, imitation grape, oil of wintergreen leaf, anise, two imitation pineapple, cinnamon, four coffees, imitation burnt almond, imitation pistache, custard type flavoring, imitation Jamaica rum and Mapleine.

Each of the above flavors was checked as an individual flavoring by adding one, two and four drops to thirty cubic centimeter portions of the simulated drink. This was done to give a rough determination of the proper strength to use and to eliminate the obviously undesirable flavors. A major portion of the flavors were discarded because they were artificial or unpleasing.

Selected Flavors

The following flavors were selected from the group as having the best possibilities:

Table II

Selected Flavors and Their Dilutions

	Flavoring Material	Dilution
1.	Coffee Concentrate	Use undiluted
2.	All Coffee	10% solution
3.	Barrington Hall Coffee	10% solution
4.	Sol Cafe	10% solution
5.	Butter Culture Aroma	Use undiluted
6.	Zip (butter flavor)	0.4% solution
7.	Starter Distillate (butter)	Use undiluted
8.	Rum and Butter	0.04% solution
9.	Foote and Jenks Bourbon Vanilla	Use undiluted
10.	Verity Brand Vanilla	Use undiluted
11.	Van-Sal 6 Fold Vanilla	1 to 6 dilution
12.	Cassia Oil (cinnamon)	0.04% solution
13.	Nutmeg Oil	0.04% solution
14.	Oil of Lemon	0.024% solution
15.	Imitation Butterscotch	0.032% solution
16.	Oil of Lime	0.024% solution

The coffee flavors come in different forms. For example, coffee concentrate (No. 1 in Table II) is a liquid, while the other three coffee flavors (Nos. 2, 3 and 4 in Table II) are obtained in powder form. These were made up in aqueous solution. Zip, a butter flavor, was diluted with water. The rum and butter flavor was diluted with alcohol. The vanillas were all Bourbon vanillas. The Van-Sal 6 Fold vanilla was diluted with water because it precipitated from solution if diluted with alcohol. The cassia oil, nutmeg oil, lemon oil, butterscotch and lime oil were made up in alcohol solutions.

Using thirty cubic centimeter portions of the simulated drink the following flavors were tried and judged by competent judges. The following table gives the results of the judgings:

Table III

Comparison of Flavoring Materials Used in the Simulated Drink

	Flavoring Material	Dilution	Drops	Dominant Characteristic
1.	Coffee Concentrate	Undiluted	1	Harsh burnt coffee
			2	Harsh burnt coffee
			4	Harsh burnt coffee
2.	All Coffee	10% Sol.	2	No character
			4	Flat
			10	Excellent coffee
3.	Barrington Hall Coffee	10% Sol.	2	No character
			4	No character
			10	Good coffee
4.	Sol Cafe (coffee)	10% Sol.	2	No character
			4	No character
			10	Good coffee
5.	Butter Culture Aroma	Undiluted	2	Slight burnt taste
			10	Acetic acid
			40	Acetic acid
6.	Zip (butter flavor)	0.4% Sol.	2	Acetic acid
			10	Acetic acid
7.	Starter Distillate (butter flavor)	Undiluted	2	Burnt sugar
			10	Acetic acid
8.	Rum and butter	0.04% Sol.	2	No character
			4	Artificial
			10	Artificial
9.	Foote and Jenks (Bourbon vanilla)	Undiluted	1	No character
			2	Good vanilla
			4	Too much vanilla
10.	Verity Brand (Bourbon vanilla)	Undiluted	1	No character
			2	Good vanilla
			4	Too much vanilla
11.	Van-Sal Bourbon (6 Fold vanilla)	1 to 6 dilution	1	No character
			2	Good vanilla
			4	Too much vanilla

The All Coffee powder (No. 2 in Table III) gave the most desirable coffee flavor. The price was noted and found to be twice that of the other coffees; however, it was considered far superior to the other coffees. None of the butter flavors appeared to be particularly desirable. There seemed to be little difference in the vanillas. These were all good grades of Bourbon vanillas.

The All Coffee powder (No. 2), Butter Culture Aroma (No. 5), Starter Distillate (butter flavor, No. 7), and one of the vanillas were tried in

various combinations, with and without cinnamon, nutmeg, lemon oil, lime oil and imitation butterscotch. Thirty cubic centimeter portions of the simulated drink were used in checking each of these flavors.

Table IV gives the results of the desirability of these various selected flavor combinations.

Table IV

Preliminary Test of Desirability of Selected Flavor Combination

No.	Flavoring Material	Drops of Flavoring	Dominant Flavor and Remarks
1.	All Coffee	10	Nice coffee
2.	All Coffee	10	About the same as 1 -
	Vanilla	2	Desirable
3.	All Coffee	10	Too strong of acetic acid
	Butter Culture Aroma	10	
4.	All Coffee	10	Too strong of acetic acid
	Starter Distillate	10	
5.	All Coffee	10	Too strong
	Butter Culture Aroma	10	
	Vanilla	2	
6.	All Coffee	10	Too strong
	Butter Culture Aroma	10	
	Vanilla	2	
	Cinnamon	2	
7.	All Coffee	15	Pale taste, has possibil-
	Starter Distillate	10	ities
	Vanilla	10	
8.	All Coffee	15	Too much cinnamon
	Starter Distillate	10	
	Vanilla	10	
	Cinnamon	1	
9.	All Coffee	15	Not undesirable
	Starter Distillate	10	
	Vanilla	10	
	Cinnamon	½	
10.	All Coffee	15	Too much nutmeg
	Starter Distillate	10	
	Vanilla	10	
	Cinnamon	1	
	Nutmeg	1	
11.	All Coffee	10	Has possibilities
	Vanilla	10	
	Cinnamon	2	
	Nutmeg	1	
	Butterscotch	2	

Table IV (Cont'd.)

No.	Flavoring Material	Drops of Flavoring	Dominant Flavor and Remarks
12.	All Coffee	10	Too much cinnamon
	Vanilla	10	
	Cinnamon	2	
	Butterscotch	2	
13.	All Coffee	10	Too strong of nutmeg
	Vanilla	10	
	Nutmeg	1	
	Butterscotch	1	
14.	Vanilla	10	Too much nutmeg
	Nutmeg	1	
15.	Vanilla	10	Cinnamon, soft flavor
	Cinnamon	2	
	Butterscotch	1	
16.	Vanilla	10	Too strong of cinnamon
	Cinnamon	2	
	Nutmeg	1	
	Butterscotch	1	
17.	All Coffee	10	Too much butter
	Vanilla	10	
	Starter Distillate	10	
	Butterscotch	1	
18.	All Coffee	10	Too much lemon, too strong
	Vanilla	10	
	Cinnamon	2	
	Butterscotch	1	
	Oil of Lemon	3	
19.	All Coffee	10	Puzzling, dominant flavor, hard to identify
	Vanilla	10	
	Cinnamon	2	
	Nutmeg	1	
	Butterscotch	1	
	Oil of Lime	2	

As reported in Table IV, nineteen flavor combinations were tried. The All Coffee (No. 1) and the All Coffee and vanilla (No. 2) gave the most pleasing results. All the other flavors tested were considered less desirable.

Table V gives the results of the effect of various amounts of twelve of the nineteen flavor combinations used in the preliminary test of the desirability of selected flavor combinations reported in Table IV.

Because of the limited supply of Starter Distillate (butter), the

flavor combinations using this material were made up in six cubic centimeter volumes. All of the other flavoring materials were made up in thirty cubic centimeter volumes. After these flavoring materials were mixed, varying amounts of the flavoring materials were added to thirty cubic centimeter aliquots of the simulated drinks. This flavored drink was then judged. The dominant character and pertinent remarks regarding the flavor of the various amounts of the different flavor combinations is recorded in the last column of Table V.

Table V

Effect of Various Amounts of Selected Flavor Combinations When Added to 30 cc. of the Simulated Drink

No.	cc.	Flavoring Material	Dilution	Drops of Flavoring Material Added to 30 cc. of Simulated Drink	Dominant Character and Remarks
1.	5.5	Van-Sal	1 to 6	10	Slight coffee
	24.5	All Coffee	10% Sol.	5	Coffee, undesirable
				3	Undesirable
2.	5.0	Van-Sal	1 to 6	10	Definite coffee
	24.5	All Coffee	10% Sol.	5	No character
	0.5	Cinnamon	0.04% Sol.	3	No character
3.	6.0	All Coffee	10% Sol.	5	Burnt sugar
	1.0	Starter Distillate (Butter)	Undiluted	3	Butter distinct
				2	No character
4.	2.3	Van-Sal	1 to 6	5	No character
	1.0	Starter Distillate (Butter)	Undiluted	3	Butter, fair flavor
	3.4	All Coffee	10% Sol.	2	No character
5.	2.3	Van-Sal	1 to 6	5	Coffee and burnt sugar
	1.0	Starter Distillate (Butter)	Undiluted	3	Butter, fair
	3.4	All Coffee	10% Sol.	2	No character
	0.2	Cinnamon	0.04% Sol.		
6.	12.0	All Coffee	10% Sol.	10	Artificial
	2.4	Butterscotch	0.023% Sol.	5	Nutmeg, too strong
	12.0	Van-Sal	1 to 6	3	Too sweet, otherwise desirable
	2.4	Cinnamon	0.04% Sol.		
	1.2	Nutmeg	0.04% Sol.		

Table V (Cont'd.)

No.	cc.	Flavoring Material	Dilution	Drops of Flavoring Material Added to 30 cc. of Simulated Drink	Dominant Character and Remarks
7.	25.0	Van-Sal	1 to 6	10	Nutmeg, too strong
	2.5	Nutmeg	0.04% Sol.	5	Nutmeg, desirable
	2.5	Cinnamon	0.04% Sol.	3	No character
8.	12.0	All Coffee	10% Sol.	10	Lime, too strong
	1.2	Butterscotch	0.023% Sol.	5	Lime, too strong
	12.0	Van-Sal	1 to 6	3	Lime, too strong
	2.4	Cinnamon	0.04% Sol.		
	1.2	Nutmeg	0.04% Sol.		
	1.2	Oil of Lime	0.024% Sol.		
9.	23.1	All Coffee	10% Sol.	10	No character
	4.6	Cinnamon	0.04% Sol.	5	No character
	2.3	Butterscotch	0.032% Sol.	3	Has possibilities
10.	19.5	All Coffee	10% Sol.	10	Nutmeg, desirable
	7.5	Van-Sal	1 to 6	5	No character
	2.2	Cinnamon	0.04% Sol.	3	No character
	0.7	Nutmeg	0.04% Sol.		
11.	6.0	All Coffee	10% Sol.	5	Bitter
	0.6	Butterscotch	0.032% Sol.	3	Lime, desirable for those who like lime
	6.0	Van-Sal	1 to 6		
	0.9	Cinnamon	0.04% Sol.		
	0.6	Nutmeg	0.04% Sol.		
	0.3	Lime Oil	0.024% Sol.		
12.	2.3	Van-Sal	1 to 6	10	Too much butter
	1.0	Starter Distillate (Butter)	Undiluted	8	Too sweet, otherwise desirable
	1.0	All Coffee	10% Sol.	3	No character

From the data in Table V, it can readily be seen that the amount and kind of flavoring used has a bearing on the acceptability of a malted milk. Of the twelve flavors made up, Nos. 1, 7 and 12 (Table V) were selected as having commercial possibilities.

Acidity Level

All drinks in Table V were allowed to stand in the refrigerator overnight and were rescored. On the second scoring all the malted milks containing the spice flavors were too strong. One assumption was that

lactic acid formation was responsible for this change. A study of the effect of adding a small amount of acid to the drink was made. Table VI shows the influence of adding one drop of ten per cent hydrochloric acid solution to each thirty cubic centimeter portions of the simulated drink containing selected amounts of the twelve flavor combinations used in Table V. The samples were run in duplicate. To the control samples no acid was added. To the experimental samples one drop of ten per cent hydrochloric acid was added. The drinks were scored immediately. The acidified samples were checked against the control samples by competent judges.

Table VI

Effect of Increased Acidity Level on Flavor Combinations

Flavor No.*	Ingredients	Drops of Flavoring	Drink with Added Acid	Drink with no Acid
1	Vanilla	5	No character	Desirable
	Coffee	3	No character	No character
2	Vanilla	5	No character	No character
	Coffee	3	No character	No character
	Cinnamon			
3	Coffee	5	Undesirable	Undesirable
	Butter	3	Undesirable	Undesirable
4	Coffee	5	No character	No character
	Butter	3	No character	No character
	Vanilla			
5	Vanilla	3	Bitterness gone, still not a good flavor	Undesirable
	Butter			
	Coffee			
	Cinnamon			
6	Coffee	5	Undesirable	Undesirable
	Butterscotch	3	Undesirable	Undesirable
	Vanilla			
	Nutmeg			
	Cinnamon			
7	Vanilla	5	Desirable	Desirable
	Nutmeg	3	Desirable	Desirable
	Cinnamon			
8	Coffee	2	Undesirable	Undesirable
	Vanilla			
	Butterscotch			
	Cinnamon			
	Nutmeg			
	Lime			

Table VI (Cont'd.)

Flavor No.*	Ingredients	Drops of Flavoring	Drink with Added Acid	Drink with no Acid
9	Coffee Cinnamon Butterscotch	3	Undesirable	Undesirable
10	Coffee Vanilla Cinnamon Nutmeg	10 3	Undesirable Undesirable	Undesirable No character
11	Coffee Butterscotch Vanilla Cinnamon Nutmeg Lime	3	Undesirable, too strong	For those who like lime
12	Vanilla Butter Coffee	8 5	Too strong Too strong	Too strong Desirable

Increasing the acidity level in the samples did not improve the flavors. In many instances it detracted from the desirability of the drink. Flavor No. 7 (Table VI) was acceptable with the added acid and also without the acid. This was the only sample acceptable with the increased acidity.

Consumer Acceptability of Three Select Flavors

Since Flavors No. 1, 7 and 12 were judged to be the best of the twelve flavors described in Tables V and VI, it was decided to run consumer acceptability tests on these three selected flavors. In order to do this, drinks using these three flavors were prepared in sixteen ounce portions, the usual commercial volume. Nine individuals rated them in the order of their preferences. To get the composite rating, each time a flavor combination was rated first, it received three points, second two points, and third one point. The composite rating was the total of these points.

---

* Flavor Numbers Correspond with Table V.

Table VII

Consumer Acceptability Rating of Three Best Flavor Combinations

Flavor No.	Ingredients	Times Rated First	Times Rated Second	Times Rated Third	Composite Rating	Remarks
1	Vanilla Coffee	5	3	1	22	Good flavor
7	Vanilla Nutmeg Cinnamon	1	3	5	14	
12	Vanilla Coffee Butter	3	2	4	17	Too sweet

The mixes of each of the three flavors in Table VII contained the same amount of sugar. However, the drink made with flavor No. 12 was criticized as being too sweet.

Effect of Varying the Amount of Sweetening on the Acceptability of Flavors No. 1 and No. 12

As a result of the consumer acceptability ratings reported in Table VII, it was found that the drink made with flavor No. 12 had a desirable flavor, but was too sweet for most of the judges. Because of this fact, it was thought that the mix using flavor No. 12 might be developed into a sugar saving formula which would meet with consumer acceptance. To test this possibility, six simulated drink mixes were made containing varying amounts of sweetening, ranging from 7.77 per cent to 18.59 per cent total sweetening. The total sweetening was calculated by adding the percentages of sucrose, dextrose and ninety-one per cent of the Plenty Powder #2 (ninety-one per cent of Plenty Powder #2 is dextrose). Table VIII gives in detail the composition of the six simulated drink mixes. Mix No. 6 in Table VIII was the control and had the same composition as the simulated drinks which had been used in the preceding tests.

Table VIII

Composition in Grams and Per Cent of Six Simulated Drink Mixes with Varying Sugar Levels

Ingredients	Mix No. 1		Mix No. 2		Mix No. 3		Mix No. 4		Mix No. 5		Mix No. 6*	
	Gms.	Per Cent	Gms.	Per Cent	Gms.	Per Cent	Gms.	Per Cent	Gms.	Per Cent	Gms.	Per Cent
Whole Milk Powder	29.4	9.6393	28.5	9.3443	27.5	9.0163	25.9	8.4918	24.5	8.0327	23.4	7.6721
Plenty Powder #2	22.3	7.3114	21.5	7.0491	20.8	6.8196	19.6	6.4262	18.5	6.0655	17.6	5.7705
Dextrose	1.7	0.5573	5.0	1.6393	8.8	2.8852	12.8	4.1967	17.9	5.8688	21.7	7.1111
Sucrose	1.7	0.5573	4.2	1.3770	6.4	2.1639	12.1	3.9672	15.7	5.1803	19.0	6.2295
Cocoa	6.8	2.2262	6.6	2.8196	6.4	2.1639	6.0	1.9672	5.7	1.8688	5.4	1.7705
Malted Milk Powder	3.4	1.1131	3.3	1.4098	3.2	1.0819	3.1	1.0163	2.9	0.9508	2.8	0.9181
Water	119.7	39.2459	115.9	37.0164	111.9	36.6885	105.5	34.5901	99.8	32.7213	95.1	31.1803
Whole Milk	120.0	39.3442	120.0	39.3443	120.0	39.3442	120.0	39.3442	120.0	39.3442	120.0	39.3442
Total	305.0	99.9947	305.0	99.9996	305.0	100.1635	305.0	100.0097	305.0	100.0324	305.0	99.9963
Total Sweetening	23.7	7.7705	28.8	9.4442	34.1	11.1803	42.7	14.0000	50.4	16.5246	56.7	18.5901

* This mix was the control sample.

The mixes described in Table VIII were made up in thirty cubic centimeter portions. Duplicate samples on each sugar level were used. Flavor No. 1 was added to one sample and used as the control, and Flavor No. 12 was added to the other sample. The influence of the sugar concentration on the acceptability of Flavors No. 1 and No. 12 may be seen in Table IX.

Table IX

Influence of Various Sugar Concentrations on Consumer Acceptability of the Simulated Drink Mixes of Flavors No. 1 and No. 12

Mix No.	Per Cent Sweetening	Acceptability of Flavor No. 1, Coffee, Vanilla	Acceptability of Flavor No. 12, Coffee, Vanilla, Butter
1	7.77	Not sweet enough	Not sweet enough
2	9.44	Not sweet enough	Not sweet enough
3	11.18	Not sweet enough	Not sweet enough
4	14.00	Not sweet enough	Right sweetness
5	16.52	Right sweetness	Too sweet
6	18.59	A little sweet	Too sweet

From the data in Table IX, it appears that Flavor No. 1 requires 16.52 per cent sweetening, while Flavor No. 12 requires 14.00 per cent sweetening to give an acceptable dulcitude. It is apparent that a two and a half per cent sugar saving could be realized by using Flavor No. 12.

Commercial Acceptability

The most promising flavors for commercial use were selected and sent to a concern interested in malted milk drinks and milk shakes. The flavors sent were Nos. 1, 6, 7, 9, 10, and 12 (See Table IV). In the commercial plant they were used in drinks and judged by competent judges. No. 1, a coffee and vanilla combination, was chosen as the best and was considered worth using commercially.

The percentage composition used in making Flavor No. 1 was 8.2 per cent Kellogg All Coffee (dry weight), 3.1 per cent Van-Sal (6 Fold vanilla) and 88.7 per cent water. The coffee was put into solution with tap water. To season a malted milk drink or a milk shake, 1.16 per cent of the above dilution was needed. To concentrate the flavor, the amount of water was decreased. The final flavor composition was 19.5 per cent Kellogg All Coffee (dry weight), 7.3 per cent Van-Sal (6 Fold vanilla) and 73.1 per cent water. At this concentration 0.5 per cent by volume of the flavoring material was required to give a satisfactory flavor to a malted milk drink or a milk shake.

Studies of Practical Forms in which Malted Milk Drinks May be Marketed

The commercial company interested in this project made three suggestions as to the form which might be used in marketing the malted milk drink. The first one was that a new product be made which could be shipped as a powder containing all the ingredients necessary except the water for the finished malted milk or milk shake. In order to guarantee a standard product with no variation from batch to batch, it was recommended that the product be made in a powder form. A measured amount of water could then be added to this powder before freezing. This would eliminate some of the necessary dipping needed in making malted milk drinks. The customary proportions used in making malted milks includes two No. 16 dips of ice cream, one and one-half ounces of chocolate syrup and four ounces of milk.

The second suggestion was to freeze an ice cream base product containing everything but the milk and to put it up in containers of uniform size. The drink could then be made by adding the milk to the frozen ice cream base and whipping.

The third suggestion was that everything including the milk be bottled; then frozen to a mush and stored at a temperature of 30° F. At the time of sale the product would be whipped. A trial drink was made to determine the effect of including all the ingredients; and then pasteurizing, bottling and chilling the product for whipping at the fountain. This project was abandoned because the body and the texture of the drink was not characteristic of a malted milk. This method produced a sub-standard product which resembled melted ice cream.

The first and second suggestions were carried out by making up an ice milk. The term, ice milk, refers to a low fat product similar to ice cream, containing the milk solids, fat, water, stabilizer and flavoring. After freezing the ice milk, it was cut and weighed into portions which varied from 170 to 190 grams. To each of these portions was added 120 cubic centimeters of milk at 40° F., and the mixture was then whipped for a period of one minute. Table X shows the volume of the finished drinks after whipping for one minute.

Table X

Volumes Obtained on Whipping Ice Milk and Milk for One Minute

Weight of Ice Milk in Grams	Volume of Finished Drink in Cubic Centimeters
165	350
180	380
175	360
175	370
185	380
205	450
190	410
180	400
185	400
200	400
Average 184	390

It appears from the data on Table X that the volume obtained from all but one of the drinks was below the standard accepted volume of 450 cubic centimeters, the average being 390 cubic centimeters. This lack of volume would adversely affect the commercial value of the drink.

In connection with the problem of trying to find an acceptable form in which to market these malted milk drinks, the effect of pasteurization on the flavor of the coffee-vanilla or vanilla type flavor combinations needed investigation. The following experiments were performed to test the effect of pasteurization upon these flavors.

Effect of Pasteurization on the Flavor of Coffees and Vanillas

Since the flavor of the drinks in Table X was largely dissipated during pasteurization, an attempt was made to find a vanilla and a coffee that would not be affected by pasteurization. To determine the effect of pasteurization, twenty-one different vanillas and vanilla type flavors and five coffees were studied. The vanillas are listed in Table XI.

Table XI

Vanillas Used for Checking the Effect of Pasteurization on Flavor

No.	Brand and Type of Flavor
1.	Kelloggs, Pure French Vanilla Extract
2.	Kelloggs, Pure Mexican Vanilla Extract
3.	Kelloggs, Pure Bourbon Vanilla Extract
4.	Van-Sal Mexican Pure Vanilla
5.	Van-Sal Pure Vanilla Extract (South American)
6.	Massey's Peerless Pure Bourbon Vanilla
7.	Massey's Royal Pure Mexican Vanilla
8.	Massey's Coronet Pure Mexican Vanilla
9.	Massey's Pure French Vanilla
10.	Virginia Dare Pure Vanilla Extract No. 7 (Blended)
11.	Verity Brand Bourbon and Mexican
12.	Blanke-Baer Pure Vanilla Extract No. 22 (Blended)
13.	Massey's Pure Vanilla Concentrate
14.	Van-Sal 6 Fold Vanilla Concentrate

Table XI (Cont'd.)

No.	Brand and Type of Flavor
15.	Blanke-Baer Pure Vanilla Extract and Synthetic Vanillin
16.	Blanke-Baer BBB Imitation Vanilla Extract
17.	Massey's Paragon Brand Pure Vanilla and Vanillin
18.	Massey's The New 2A Imitation Vanilla
19.	Cleveland Fruit Juice Co. Vanillin and Coumarin Compound
20.	Van-Sal Senior Concentrate
21.	Warner-Jenkison Vanilla and Vanillin No. 56

The coffees were Lurient Coffee Concentrate, Sol Cafe, Kellogg's All Coffee, Barrington Hall Coffee and NesCafe.

Procedure for Testing the Effect of Pasteurization on Vanillas

A test was made using the following procedure: each concentrated vanilla was diluted to the strength of ordinary vanilla. Each dilution was made according to the reported concentration given on each bottle. Two series of thirty cubic centimeter portions of the simulated drink, using the original sugar level, were made. To one series 0.3 cubic centimeters of a given vanilla was added before pasteurization. The flavoring was added to the other series after pasteurization. The flavors of the two series were compared by competent judges. The effect of pasteurization on the flavors of the various vanillas and vanilla type flavorings is given in Table XII. The order of the tests reported in Table XII is the same as that in Table XI.

Table XII

Effect of Pasteurization on the Flavor of Various Vanillas and Vanilla Type Flavorings when Used in a Simulated Malted Milk Drink

Type of Vanilla	Comparison of Pasteurized and Unpasteurized Flavor
1. French	Artificial before and after pasteurization
2. Mexican	Faded on pasteurization
3. Bourbon	Faded on pasteurization

Table XII (Cont'd.)

Type of Vanilla	Comparison of Pasteurized and Unpasteurized Flavor
4. Mexican	Faded on pasteurization
5. South American	Faded on pasteurization
6. Bourbon	Faded on pasteurization
7. Mexican	Weak before and after pasteurization
8. Mexican	Not desirable, poor vanilla
9. French	Coarse, artificial vanilla, faded
10. Blended vanilla	Faded on pasteurization
11. Mexican and Bourbon	Faded on pasteurization
12. Blended vanilla	Faded on pasteurization, weak
13. Concentrate	Faded on pasteurization, weak
14. Concentrate	Faded on pasteurization
15. Vanilla and Vanillin	Stronger after pasteurization, artificial
16. Imitation Vanilla	Faded on pasteurization
17. Vanilla and Vanillin	Faded on pasteurization
18. Imitation Vanilla	No fading, artificial
19. Vanillin and Coumarin	Faded on pasteurization
20. Concentrate	Big loss of flavor
21. Vanilla and Vanillin	Weak before and after pasteurization

It is apparent that all pure vanillas lose some of their flavoring on pasteurization (Table XII). One flavor (No. 15, Table XII), a vanilla and vanillin combination, appeared to be stronger after pasteurization than before, but its flavor was artificial, making it undesirable.

Effect of Pasteurization on the Flavor of Selected Coffee and Vanilla Combinations

In determining the effect of pasteurization on coffee and vanilla in combination, a selection of the vanillas was made to include one of each type except the French vanillas. These were omitted from the test because they did not prove to be acceptable before or after pasteurization. The vanillas selected were (1) Kellogg's Pure Bourbon Vanilla Extract, (2) Massey's Royal Pure Mexican Vanilla, (3) Verity Brand Mexican and Bourbon, (4) Blanke-Baer's Pure Vanilla Extract with Synthetic Vanillin, (5) Massey's Paragon Brand Pure Vanilla and Vanillin, (6) Massey's The New 2A Imitation Vanilla and (7) Cleveland Fruit Juice Company Vanillin

and Courmarin Compound.

The four powdered coffees were made up in ten per cent solutions in water. The Lurient coffee concentrate was diluted to half its original strength with water. Equal portions of coffee solution and vanilla were used to make the flavoring. Each thirty cubic centimeter portion of the simulated drink was flavored with 0.3 cubic centimeter of a given flavoring. One series was flavored before pasteurization and the other series after pasteurization. The flavors of the two series were compared by competent judges.

All these coffee-vanilla combinations had been scored previously. The All Coffee-vanilla combination was found to be superior to the other coffee-vanilla combinations. The Barrington Hall, Sol Cafe and NesCafe in combination with vanilla gave a mediocre product. The Lurient coffee-vanilla combination did not produce an acceptable product. However, it seemed advisable to test the effect of pasteurization on each of these coffee-vanilla combinations. The effect of pasteurization on the flavor of each of these five coffees with seven different vanilla and vanilla type flavorings is tabulated in Table XIII.

Table XIII

Effect of Pasteurization on the Flavor of Selected Coffee and Vanilla Combinations when Used in a Simulated Malted Milk Drink

No.	Type Vanilla	Coffee	Comparison of Pasteurized and Unpasteurized Flavors
1.	Bourbon	All Coffee	Weak after pasteurization
	Bourbon	Barrington Hall	Weak after pasteurization
	Bourbon	Sol Cafe	Weak after pasteurization
	Bourbon	NesCafe	Weak after pasteurization
	Bourbon	Lurient	Harsh, burnt taste

Table XIII (Cont'd.)

No.	Type Vanilla	Coffee	Comparison of Pasteurized and Unpasteurized Flavors
2.	Mexican	All Coffee	Weak after pasteurization
	Mexican	Barrington Hall	Weak after pasteurization
	Mexican	Sol Cafe	Weak after pasteurization
	Mexican	NesCafe	Weak after pasteurization
	Mexican	Lurient	Harsh, burnt taste
3.	Mexican-Bourbon	All Coffee	Weak after pasteurization
	Mexican-Bourbon	Barrington Hall	Weak after pasteurization
	Mexican-Bourbon	Sol Cafe	Weak after pasteurization
	Mexican-Bourbon	NesCafe	Weak after pasteurization
	Mexican-Bourbon	Lurient	Harsh, burnt flavor
4.	Vanilla-Vanillin	All Coffee	Rough flavor, flavor holds
	Vanilla-Vanillin	Barrington Hall	Rough flavor, flavor holds
	Vanilla-Vanillin	Sol Cafe	Rough flavor, flavor holds
	Vanilla-Vanillin	NesCafe	Rough flavor, flavor holds
	Vanilla-Vanillin	Lurient	Rough flavor, flavor holds
5.	Vanilla-Vanillin	All Coffee	Faded on pasteurization
	Vanilla-Vanillin	Barrington Hall	Faded on pasteurization
	Vanilla-Vanillin	Sol Cafe	Faded on pasteurization
	Vanilla-Vanillin	NesCafe	Faded on pasteurization
	Vanilla-Vanillin	Lurient	Harsh, burnt coffee
6.	Imitation Vanilla	All Coffee	Powerful flavor, artificial
	Imitation Vanilla	Barrington Hall	Powerful flavor, artificial
	Imitation Vanilla	Sol Cafe	Powerful flavor, artificial
	Imitation Vanilla	NesCafe	Powerful flavor, artificial
	Imitation Vanilla	Lurient	Powerful flavor, harsh

Table XIII (Cont'd.)

No.	Type Vanilla	Coffee	Comparison of Pasteurized and Unpasteurized Flavors
7.	Vanillin-Coumarin	All Coffee	Faded on pasteurization
	Vanillin-Coumarin	Barrington Hall	Faded on pasteurization
	Vanillin-Coumarin	Sol Cafe	Faded on pasteurization
	Vanillin-Coumarin	NesCafe	Faded on pasteurization
	Vanillin-Coumarin	Lurient	Harsh coffee

Since most of the flavors faded on pasteurization, it would appear impractical to add the flavoring to the mix before pasteurization (Tables XII and XIII).

Stabilizers

Since gelatin is an excellent stabilizer and gives a standard product, in most of this experimental work gelatin was the stabilizer used. However, it seemed desirable that the use of some gum stabilizers be investigated. Sodium alginate, which is an Irish moss derivative (sold commercially as Dariloid), and high viscosity sodium carboxymethocellulose, called CMC (sold by the Dow Chemical Company), were chosen for this work. To determine the amount necessary for stabilization of a malted milk, a series of samples containing different percentages of the gums were set up.

Each malted milk contained two hundred cubic centimeters milk, four grams cocoa, one gram malted milk powder, thirty grams sugar, six-hundreths of a gram of salt and the stabilizer. One cubic centimeter of the flavoring was added after the pasteurization and cooling period. The percentages of stabilizer used were 0.25, 0.35, 0.75, and 1.0. The dry ingredients were all thoroughly mixed and added to the milk when it

reached a temperature of 160° F. The milk solution was stirred and held at 180° F. for fifteen minutes. When the drinks had cooled to 32° F., they were whipped one minute on the Hamilton-Beach mixer and the volume measured. The effect of varying amounts of the gum stabilizers on the body and volume of the malted milk drinks appears on Table XIV.

Table XIV

Effect of Varying Amounts of Gum Stabilizers on the Volume and Body of a Malted Milk

Drink No.	Per Cent	Stabilizer	Volume of Finished Drink	Body
1.	0.25	Dariloid	350 cc.	Too thin
2.	0.35	Dariloid	400 cc.	Right
3.	0.50	Dariloid	380 cc.	Too thick
4.	0.75	Dariloid	370 cc.	Too thick
5.	1.00	Dariloid	360 cc.	Too thick
6.	0.25	CMC	340 cc.	Too thin
7.	0.35	CMC	380 cc.	Right
8.	0.50	CMC	370 cc.	Too thick
9.	0.75	CMC	300 cc.	Too thick
10.	1.00	CMC	280 cc.	Too thick

The data recorded in Table XIV shows that 0.35 per cent of either Dariloid or CMC gave a body suitable for a malted milk. The volumes of the finished drinks made with this amount of stabilizer were greater than at any other levels. The Dariloid gave a volume of 400 cubic centimeters and the CMC a volume of 380 cubic centimeters. The flavor of the product made with Dariloid was indistinguishable from that made with gelatin. While the flavor of the malted milk made with CMC was smooth and bland, it required a larger amount of flavoring to give the same intensity of flavor as that made with gelatin.

Effect of Fat on the Finished Volume of a Malted Milk Drink

Because many commercial establishments use ice milk rather than ice cream for making malted milks, and because it is a known fact that when gelatine is used as a stabilizer there is an inverse relationship between the volume of the finished drink and the amount of fat in the product, it seemed desirable to study the effect of fat on the volume of malted milks made with these gum stabilizers. Therefore, a study of the effect of fat on the finished volume of the drink was made by using the same formula as employed in the previous experiment and using 0.35 per cent of the gum stabilizer. Four malted milks were made containing Dariloid and four containing CMC. Two of the drinks with each stabilizer were made with whole milk and two with skim milk. The finished drink made with shole milk contained 3.0 per cent butterfat, while that made with skim milk contained 0.01 per cent butterfat. The whipping time for each drink was one minute and the temperature at which the drink was whipped was 32° F.

Table XV

The Effect of Fat on the Volume of a Malted Milk Drink

Drink No.	Stabilizer	Volume of Finished Drink	Per Cent Fat	Average Volume of Finished Drink
1.	Dariloid	300 cc.	3.0	300 cc.
2.	Dariloid	300 cc.	3.0	
3.	CMC	350 cc.	3.0	375 cc.
4.	CMC	400 cc.	3.0	
5.	Dariloid	370 cc.	0.01	385 cc.
6.	Dariloid	400 cc.	0.01	
7.	CMC	400 cc.	0.01	390 cc.
8.	CMC	380 cc.	0.01	

It can be seen (Table XV) that the average volume of the malted milks made with skim milk (0.01 per cent butterfat) was 390 cubic centi-

meters, while that made with whole milk (3.0 per cent butterfat) was only 375 cubic centimeters. It appears that as the fat content increased, the volume of the finished drink decreased.

Effect of Storage on the Finished Volume of Malted Milk Drinks

Because previous experiments reported in the literature record "wheying off" of ice cream mixes when stored, the preceding experiment was repeated using skim milk alone and storing the drinks for three days at 42° F. before whipping. Four samples, using each stabilizer were made up. After storage the drinks were whipped for one minute at 32° F. The effect of storage on the finished volume of the malted milks is recorded in Table XVI.

Table XVI

Effect of Storage on the Finished Volume of Malted Milk Drinks

	Volume of Finished Drink Made with Dariloid	Volume of Finished Drink Made with CMC
	500 cc.	500 cc.
	470 cc.	460 cc.
	510 cc.	470 cc.
	580 cc.	460 cc.
Average	515 cc.	472.5 cc.

By comparing the data in Table XV with the data in Table XVI, it is noted that storing the malted milk drink for three days increases the volume of the drink when finished. For example, the average volume of the drink containing Dariloid was 385 cubic centimeters when used immediately. After storing for three days before whipping, a volume of 515 cubic centimeters was obtained. The trend shown in Table XV is that the malted milks made from skim milk with Dariloid gave a larger volume

than the ones made with CMC. Using Dariloid as a stabilizer there was a variation ranging from 470 to 580 cubic centimeters in the volume of the drink whipped after storage of three days. The same trend followed in the drinks made with CMC. There is no doubt that storage increased the volume of the finished drink.

Method of Incorporating the Flavor into the Finished Malted Milk

The usual method of making malted milk drinks is to measure separately the milk, chocolate syrup and the malted milk powder into the mixer and then whip. This is not only time-consuming, but increases the chances of deviation from a standard product due to inaccuracies in measuring. It is believed that a standard product could be insured if the measuring of the milk and syrup could be done in one operation. The drink would be finished by the addition of ice cream and whipping. A number of different methods of incorporating the flavor into the malted milk were tried. The final method of incorporating the flavor into the drink consisted of combining the syrup and flavoring material with the milk.

DISCUSSION

The experiments performed show some of the many variables which affect consumer acceptability of a malted milk. The kind and amount of flavoring used appears to be of major importance. The kind and amount of the materials used in the ice cream mix, the treatment of these materials before freezing and the amount of ice cream used in the finished drink also have a bearing on the acceptability of these drinks.

The following percentage composition for the chocolate syrup was decided to be the most acceptable:

7.8 per cent cocoa
38.9 per cent dextrose
14.8 per cent sucrose
38.2 per cent water
0.1 per cent salt
99.8 per cent total

A chocolate milk mixture was made with the following proportions: one and one-half parts (by volume) of the above chocolate syrup, mixed with four parts of milk, and pasteurized for fifteen minutes at 180° F. After cooling, one per cent (by volume) of flavor No. 1 was added to the chocolate milk.

The following proportions were used in making a malted milk using this formula: two No. 16 dips of ice cream, five and one-half ounces of the chocolate syrup and milk mixture, and one and one-half ounces of malted milk powder. This combination of ingredients was placed in a Hamilton-Beach mixer, whipped for one minute and served. This method simplified the preparation of chocolate malted milks, and the resulting product scored satisfactorily. The drink was scored by qualified employees of a commercial ice cream company and other qualified judges. They reported the drink to be satisfactory in all respects.

CONCLUSIONS

A combination of .1 per cent Kellogg All Coffee (dry weight) and .04 per cent Van-Sal (6 Fold vanilla) was a good flavoring for a chocolate malted milk.

Dariloid and solium carboxymethocellulose when used as stabilizers in 0.35 per cent concentration were as effective in producing a standard malted drink as 0.5 per cent gelatin.

Malted milk drinks made from ice cream containing 3.0 per cent butterfat had a smaller volume than those made with ice milk containing 0.01 per cent butterfat.

Pasteurization at 180° F for fifteen minutes partially dissipated the flavors of vanilla and coffee. For this reason, we suggest the flavoring be added after pasteurization.

Mixing of the milk, chocolate syrup and other flavoring materials prior to use at the sales counter reduced the amount of dipping at the time of sale and insured a more uniform product.

BIBLIOGRAPHY

Anonymous. "Powdered Ice Cream Mix." Ice Cream Review, 29 (September, 1945), 38.

Anonymous. "Survey Analyzes Flavor Popularity, Types of Ice Cream Outlets." Ice Cream Review, 16 (May, 1933), 40.

Anonymous. "Testing Consumer Preferences and Special Reference to Constituents of Ice Cream." Ice Cream Review, 28 (January, 1945), 32.

Anonymous. "To Stretch or Not to Stretch Our Available Chocolate to Meet Public Demand." Ice Cream Review, 26 (May, 1943), 22-1.

Anonymous. "Use of Vanilla and Other Flavors in Ice Cream." Ice Cream Review, 24 (February, 1941), 114.

Baer, Samuel H. "Vanilla Bean and Vanilla Extract." Ice Cream Review, 17 (March, 1934), 32-4.

Button, F. C. "Important Factors Affecting Quality of Vanilla Ice Cream." Ice Cream Review, 16 (March, 1933), 24.

Caulfield, W. J. and Martin, W. H. "The Use of Vegetable Stabilizers in Ice Cream." Journal of Dairy Science, 16 (1933), 265.

Crocker, E. C. Flavor. New York: McGraw-Hill Book Company, 1945.

Fabricius, N. E. "Improving Chocolate Ice Cream." Ice Cream Review, 14 (August, 1930), 72.

Gould, I. A. and Lucas, P. S. "A Study of Factors Influencing the Separation of Whey in Ice Cream Mixes Containing Vegetable Stabilizers." Journal of Dairy Science, 18 (1935), 307.

Hamilton Beach Company. "Temperature Control in Making a Malted Milk." Ice Cream Review, 21 (June, 1938), 40-1.

Henderson, C. C. "Chocolate Malteds." Ice Cream Review, 24 (January, 1941), 31.

Josephson, Donald and Chester Dahle. "A New Cellulose Gum Stabilizer for Ice Cream." Ice Cream Review, 28 (June, 1945), 32.

Lucas, P. S. and Merrill, A. C. "Vanilla Flavors do not Freeze out of Ice Cream." Michigan Agricultural Experiment Station Quarterly Bulletin, 11 (1929), 118-30.

Prescott, Samuel, Arthur Heifetz and David Stanley, Jr. "Ice Cream Stabilizers." Ice Cream Review, 16 (September, 1932), 34-5.

Sommer, Hugo H. The Theory and Practice of Ice Cream Making, 2nd Edition. Milwaukee: Olson Publishing Company, 1937.

Stebnitz, V. C. and Sommer, H. H. "What Should Ice Cream Stabilizers Do." Ice Cream Review, 20 (November, 1937), 51.

Totman, C. C. "Vanilla and Vanilla Compounds." Ice Cream Review, 14 (June, 1931), 49.

Tracy, P. H. "Powdered Whole Milk and Mix." Ice Cream Trade Journal, 41, No. 4 (April, 1945), 22.

Typist: Ethellyn A. Lewis