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The Effect of Serving Temperature Upon Consumer Acceptance of Ice Creams and Sherbets

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The Effect of Serving Temperature Upon Consumer Acceptance of Ice Creams and Sherbets

W. H. E. REID AND W. S. ARBUCKLE*

The temperature of ice cream as it is served to the consuming public is a factor of major importance in presenting a product that will fully meet the demands of a favorable consumer acceptance. An ice cream served at a relatively low temperature may have a cold and submerged flavor, a resistant body, and may be considered unpleasant for consumption. The same product when served at a higher temperature may be too pronounced in flavor, lack resistance, and be unpalatable. Although frozen desserts are very sensitive to temperature changes, the serving temperature has been given very little scientific thought and as a result the consumer has been presented with a product varying greatly in temperature and quality. The object of the investigation here reported was to secure information concerning the most desirable serving temperature of ice creams and sherbets.

A study of the literature reveals few investigations bearing on this subject. Reid (1)[†] found that only three per cent of the ice cream manufacturers and only two per cent of the store operators displayed familiarity with the desirable serving temperature of ice cream, and that there was a considerable variation in serving temperatures. Reid further states that there is a direct relationship between the serving temperature and flavor of ice cream from the consumer's point of view. As the temperature of the ice cream reached 10 degrees Fahrenheit and exceeded that temperature, the true flavor became more apparent. The same relationship of the flavor and temperature was quite true of body, texture and stability of the ice creams except in the instances of extreme temperatures.

Reid (2) found that the consumer preference of vanilla ice cream was at 16 degrees Fahrenheit and that of the chocolate ice cream was at 10 degrees Fahrenheit when samples of ice cream were judged at serving temperatures of 6, 10, 16 and 20 degrees Fahrenheit. Reid (1) suggests that the increased sugar content of chocolate and strawberry ice creams and sherbets indicates that they should be maintained at a serving temperature considerably lower than that of vanilla ice cream.

*The data presented in this bulletin were taken from a thesis submitted by the junior author in partial fulfillment of the requirements for the degree of Master of Arts in the Graduate School of the University of Missouri, 1937.

[†]See list of references on page 34.

Reid (3) summarizes his dipping studies by concluding that the number of pints, quarts, and cones dipped from five gallons of vanilla ice cream increased as the serving temperature increased from 6 to 16 degrees Fahrenheit.

Bierman (4) concludes that to keep dipping losses at a minimum, ice cream containing 15 per cent sugar, 10 per cent M. S. N. F. should be dipped at 8 degrees Fahrenheit or lower, and for each 1 per cent variation in sugar content the dipping temperature should be varied inversely 1.0 to 1.5 degrees Fahrenheit. The consumer receives quarts of ice cream that weigh approximately 1.1 ounce less when ice cream is dipped at 3 to 8 degrees Fahrenheit in comparison to ice cream dipped at 9 to 16 degrees Fahrenheit. Turnbow and Raffeto (5) observed that the operator not the dipper is the important factor controlling shrinkage.

PROCEDURE

That the experimental work of this problem should be conducted under commercial conditions, throughout the entire experiment, rather than laboratory conditions was considered an important factor so that the results might be applied more readily to the industry.

Preparation of Ice Creams and Sherbets

The following ice creams and sherbets were used in the conduct of this investigation as they were considered to be representative of the most common flavors; vanilla, chocolate, strawberry, tutti-frutti, chip chocolate, orange-pineapple and black walnut ice creams, and orange, lime, pineapple and raspberry sherbets. All ice creams and sherbets were prepared and frozen from standard mixtures under commercial conditions. The volume of sugar and flavoring material used varied with the respective ice creams and sherbets.

TABLE 1.—THE COMPOSITION OF THE DIFFERENT MIXTURES.

Flavor	Fat Per Cent	Serum Solids Per Cent	Sugar Per Cent	Total Solids Per Cent	Overrun Per Cent	Gelatin Per Cent
Vanilla	11.00	10.75	14.50	36.25	100	.3
Chocolate	11.50	10.75	17.00	39.25	100	.3
Strawberry	11.00	10.75	18.00	39.75	100	.3
Tutti-Frutti	11.00	10.75	18.00	39.75	100	.3
Orange-Pineapple	11.00	10.75	18.00	39.75	100	.3
Chip-Chocolate	11.00	10.75	14.75	36.25	100	.3
Black Walnut	11.00	10.75	18.00	39.75	100	.3
Orange sherbet	2.20	2.15	16.50	21.15	35	.3
Pineapple sherbet	2.20	2.15	15.30	19.95	35	.3
Lime sherbet	2.20	2.15	16.50	21.15	35	.3
Raspberry sherbet	2.20	2.15	18.80	23.45	35	.3

The overrun of the ice creams was standardized at 100 per cent, and the sherbets 35 per cent. Representative samples of each ice cream or sherbet were obtained at the freezer and immediately placed into a hardening room where a uniform temperature of -10 degrees Fahrenheit was maintained.

Preliminary Survey of Serving Temperatures

A survey (6) of sixty ice cream dispensing establishments and an examination of 106 samples of ice creams and sherbets revealed that there was a great variation in the serving temperature of ice creams and sherbets.

TABLE 2.—TEMPERATURE OF ICE CREAMS AND SHERBETS OF DIFFERENT FLAVORS.

Flavors	Samples Examined		Temperature			
	Number	Total Per Cent	Minimum °F	Maximum °F	Average °F	
Vanilla	35	33.00	2	22	14.41	Average Temperature of ice creams 11.9°F
Chocolate	17	16.37	4	18	11.50	
Strawberry	12	11.32	2	12	8.60	
Misc. Ice cream	23	21.70	2	22	10.10	
Orange sherbet	6	5.67	10	13	11.10	Average Temperature of sherbets 13.0°F
Pineapple sherbet	7	6.60	10	17	14.00	
Misc. sherbet	6	5.67	9	17	14.00	

The data obtained in the conduct of this survey show that the serving temperature of ice creams varied from 2 degrees Fahrenheit to 22 degrees with an average temperature of 11.9 degrees Fahrenheit. The range of temperature for sherbets was from 11.1 to 14.0 degrees Fahrenheit with an average of 13.0 degrees Fahrenheit.

TABLE 3.—ICE CREAMS AND SHERBETS HELD AT THE VARIOUS TEMPERATURES IN DEALER'S CABINETS.

Temperature Range of Cabinets Degrees F	Number of Samples	Per Cent of Total Samples Examined
0 to 6	17	16.04
7 to 10	33	31.13
11 to 14	28	26.41
15 to 18	22	20.75
19 to 22	6	5.67

Table 3 shows that the temperature of 47.17 per cent of the ice creams and sherbets was under 10 degrees Fahrenheit, while 47.16 per cent was between 10 and 18 degrees Fahrenheit and only 5.67 per cent had a temperature exceeding 18 degrees Fahrenheit.

From this survey, representative serving temperatures of ice creams and sherbets were chosen, i. e., 6, 10, 14 and 18 degrees Fahrenheit for ice creams and 6, 10 and 14 degrees Fahrenheit for sherbets.

Tempering of Ice Creams and Sherbets in Cabinets

After the ice creams and sherbets had been hardened they were properly tempered in commercial ice cream cabinets at the desired temperatures for 24 hours before they were judged. It was observed that the different ice creams and sherbets reached the desired temperature within that time.

Determining Consumer's Acceptance

The judges of the ice creams and sherbets, served at the different temperatures, consisted of ice cream plant executives and plant workers, ice cream manufacturers from several states who were attending regular ice cream short courses and the educational conference, members of the University home economics food class, dairy department faculty members, graduate students, and other consumers. The judges were asked to place the ice creams and sherbets with respect to flavor, body and texture preference, and, in addition, to make a final placing.

The judges were not informed as to the temperature of the ice creams and sherbets and not more than twelve samples were judged at any one period. The temperature of the room in which the observations were made was approximately 70 degrees Fahrenheit.

Effect of Serving Temperature upon Stability

In order to determine the effect of serving temperature on stability of the different ice creams and sherbets, the contents of a number 24 disher was exposed in an incubator at 85 degrees Fahrenheit. The observations made included; time required for liquid to form in the dish, time required for ice cream or sherbet to lose its fine eating qualities and time required for the ice cream to melt to mix state.

The same procedure was followed using vanilla ice cream at 10 degrees Fahrenheit in determining the relation of the stability of ice cream to the size of disher. The following different size Zeroll dishers were used; number 12, 16, 20, 24 and 30.

EXPERIMENTAL DATA

The data presented in this investigation represent the observations of the physical properties of different ice creams and sherbets made by 181 different persons. From these observations the consumer acceptance of the ice creams and sherbets was determined.

The observations and placings of vanilla ice cream at the different

TABLE 4.—RELATION OF THE SERVING TEMPERATURE TO THE CONSUMER ACCEPTANCE OF VANILLA ICE CREAM.

Serving Temperatures Degrees F.	Flavor Observations			Body Observations			Texture Observations			Final Observations		
	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Rank	Per Cent
6	3rd	Too cold, Submerged, Desirable	86.20 13.80	3rd	Smooth, Mellow, Resistant, Coarse	36.10 49.10 14.80	3rd	Close, Med. close, Very close, Open, Buttery	51.90 19.50 21.50 5.50 1.80	3rd	First Second Third Fourth	9.30 15.70 37.00 38.00
10	2nd	Too cold, Submerged, Pronounced, Too sweet, Desirable	25.00 8.30 1.90 64.80	1st	Smooth, Mellow, Resistant, Coarse	67.60 28.70 3.70	1st	Close, Med. close, Very close	49.00 41.70 9.30	2nd	First Second Third Fourth	33.30 36.10 30.60
14	1st	Too cold, Submerged, Pronounced, Too warm, Too sweet, Desirable	3.70 11.10 7.40 11.10 66.70	2nd	Smooth, Mellow, Resistant, Lacks resistance, Soggy	71.30 12.00 14.80 1.90	2nd	Close, Med. close, Very close, Open	23.10 69.40 2.80 4.70	1st	First Second Third Fourth	48.20 32.40 19.40
18	4th	Pronounced, Too warm, Too sweet, Desirable	28.70 34.30 21.30 16.70	4th	Smooth, Mellow, Lacks resistance, Soggy, Coarse	32.40 52.80 2.80 12.00	4th	Close, Med. close, Very close, Open, Buttery	1.00 30.20 5.60 53.80 9.40	4th	First Second Third Fourth	4.60 10.20 30.60 54.60

serving temperatures are shown in Table 4. The data showed that in making the final placing the judges preferred the vanilla ice cream served at 14 degrees Fahrenheit first, 10 degrees Fahrenheit second, 6 degrees Fahrenheit third, and 18 degrees Fahrenheit fourth. It is interesting to note that either the ice cream served at 14 or 10 degrees Fahrenheit was placed first by 86.10 per cent of the judges.

The flavor preference of the ice cream was 14, 10, 6 and 18 degrees Fahrenheit respectively, and the body and texture preference was 10, 14, 6 and 18 degrees. At 18 degrees Fahrenheit the flavor was criticized by 84.30 per cent of the judges as being too pronounced, too sweet or too warm, while the ice cream served at 6 degrees Fahrenheit was criticized by 86.20 per cent of the judges for being cold and submerged.

When observing the ice cream at a serving temperature of 10 degrees Fahrenheit these flavor criticisms were not as noticeable and they were reduced to a minimum at a serving temperature of 14 degrees Fahrenheit.

Ice cream served at 18 degrees Fahrenheit was criticized by 52.80 per cent of the judges for lacking resistance of body, and 53.80 per cent of the judges thought the texture was open, while ice cream served at 6 degrees Fahrenheit was recorded by 14.70 per cent of the judges as being resistant and 21.00 per cent as coarse and open in texture.

At 10 and 14 degrees Fahrenheit the greater per cent of the judges considered the body smooth and mellow and the texture close.

Table 5 presents the observations of the chocolate ice cream made by 108 people. The data show that chocolate ice cream at 10 degrees Fahrenheit was placed first, 14 degrees Fahrenheit second, 6 degrees Fahrenheit third and 18 degrees Fahrenheit fourth. It is important to observe that 79.60 per cent of the judges ranked either the ice cream at 10 or 14 degrees Fahrenheit first.

In flavor and body preference the ice cream at serving temperatures of 10, 14, 6 and 18 degrees Fahrenheit ranked first, second, third and fourth, respectively. The sugar content of the chocolate ice cream was relatively high and the body was criticized somewhat more severely at higher serving temperatures than was that of the vanilla ice cream.

The preference of the judges as regards to the texture of the ice cream was at serving temperature of 10, 6, 14 and 18 degrees Fahrenheit respectively. Apparently in chocolate ice cream the texture was more desirable at the lower serving temperatures.

TABLE 5.—RELATION OF THE SERVING TEMPERATURE TO THE CONSUMER ACCEPTANCE OF CHOCOLATE ICE CREAM.

Serving Temperatures Degrees F.	Flavor Observations			Body Observations			Texture Observations			Final Observations		
	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Rank	Per Cent
6	3rd	Too cold, Submerged, Too sweet, Desirable	75.90 1.00 23.10	3rd	Smooth, Mellow, Too resistant, Close	38.00 53.70 8.30	2nd	Close, Med. close, Very close, Open, Buttery	25.00 25.00 13.80 8.40 2.80	3rd	First Second Third Fourth	13.00 16.70 38.90 31.40
10	1st	Too cold Submerged, Too pronounced, Too sweet, Desirable	29.60 9.30 7.40 53.70	1st	Smooth, Mellow, Too resistant, Soggy, Coarse	59.30 28.70 3.70 8.30	1st	Close, Med. close, Very close, Open, Buttery	42.60 49.10 4.60 2.80 .90	1st	First Second Third Fourth	40.70 40.70 16.70 1.90
14	2nd	Too cold, Submerged, Too pronounced, Too warm, Sweet, Desirable	5.50 16.70 9.30 17.60 50.90	2nd	Smooth, Mellow, Too resistant, Lacks resistance, Soggy	64.80 4.60 28.80 1.80	3rd	Close, Med. close, Very close, Open, Buttery	23.10 56.50 1.80 16.70 1.70	2nd	First Second Third Fourth	58.90 34.30 26.80
18	4th	Too pronounced, Too warm, Too sweet, Desirable	23.70 30.10 24.50 16.70	4th	Smooth, Mellow, Lacks resistance, Soggy	32.40 52.80 14.80	4th	Close, Med. close, Very close, Open, Buttery	10.20 24.00 2.80 53.70 9.30	4th	First Second Third Fourth	5.50 10.20 25.00 59.30

TABLE 6.—RELATION OF THE SERVING TEMPERATURE TO THE CONSUMER ACCEPTANCE OF STRAWBERRY ICE CREAM.

Serving Temperatures Degrees F.	Flavor Observations			Body Observations			Texture Observations			Final Observations		
	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Rank	Per Cent
6	3rd	Too cold, Submerged, Desirable	75.50 24.50	3rd	Smooth, Mellow, Too resistant, Coarse	38.00 55.50 6.50	2nd	Close, Med. close, Very close, Open	59.60 14.90 19.10 6.40	3rd	First Second Third Fourth	12.00 34.00 43.00 11.00
10	2nd	Too cold, Submerged, Too pronounced, Too sweet, Desirable	27.60 8.50 4.30 59.60	1st	Smooth, Mellow, Resistant	48.90 41.10	1st	Close, Med. close, Very close, Open	51.10 36.20 8.50 4.20	1st	First Second Third Fourth	72.00 21.60 6.40
14	1st	Too pronounced, Too warm, Too sweet, Desirable	8.50 24.90 21.90 44.70	2nd	Smooth, Mellow, Resistant, Lacks resistance, Coarse	61.70 2.10 29.80 6.40	3rd	Close, Med. close, Very close, Open, Buttery	19.10 53.30 10.60 10.60 6.40	2nd	First Second Third Fourth	14.80 42.60 42.60
18	4th	Too pronounced, Too warm, Too sweet, Desirable	21.00 46.80 24.50 7.70	4th	Smooth, Mellow, Lacks resistance, Soggy	21.20 51.10 27.70	4th	Close, Med. close, Very close, Open, Buttery	6.40 31.40 4.30 43.00 14.90	4th	First Second Third Fourth	4.30 0.00 8.60 87.10

Table 6 shows the observations of strawberry ice cream made at different serving temperatures. The strawberry ice cream served at 10 degrees Fahrenheit was placed first, 14 degrees second, 6 degrees third and 18 degrees Fahrenheit last. The ice cream at serving temperatures of 10 or 14 degrees Fahrenheit were placed first by 86.90 per cent of the judges.

The flavor preference ranked 14, 10, 6 and 18 degrees Fahrenheit respectively. At the serving temperature of 14 degrees Fahrenheit it seemed that the true strawberry flavor was more apparent, while at lower temperatures this desirable flavor was submerged.

The body preference of the strawberry ice cream served at 10 degrees Fahrenheit was first, 14 degrees Fahrenheit second, 6 degrees Fahrenheit third and 18 degrees Fahrenheit fourth, and the texture preference was 10, 6, 14 and 18 degrees Fahrenheit respectively.

The body and texture comments were similar to those made of the chocolate ice cream.

Table 7 shows the observations of the Tutti-frutti ice cream served at different temperatures. This ice cream was pronounced in flavor and had a relatively high sugar content. The consumer preference was 10, 6, 14 and 18 degrees Fahrenheit respectively, and 77.10 per cent of the judges placed the ice cream served at 10 or 14 degrees Fahrenheit first. The comments indicate that the ice cream was preferred at these lower serving temperatures, mainly, because the flavor was less pronounced. At higher serving temperatures the flavor was criticized as being too pronounced and too sweet.

Table 8 shows the observations of the chip chocolate ice cream. The data reveal that chip chocolate ice cream at the serving temperature of 10 degrees Fahrenheit was most desirable, 14 degrees Fahrenheit second, 6 degrees Fahrenheit third, and 18 degrees Fahrenheit fourth. The composition of this ice cream was very similar to that of the vanilla and the comments made by the judges were about the same as those made of the vanilla ice cream with the exception that the flavor was more pronounced and was somewhat more desirable at a lower serving temperatures. The flavor, body and texture preference was 10, 14, 6 and 18 degrees Fahrenheit respectively.

TABLE 7.—RELATION OF THE SERVING TEMPERATURE TO THE CONSUMER ACCEPTANCE OF TUTTI-FRUTTI ICE CREAM.

Serving Temperatures Degrees F.	Flavor Observations			Body Observations			Texture Observations			Final Observations		
	Preference	Comments	Per Cent	Preference	Comments	Per Cent	Preference	Comments	Per Cent	Preference	Rank	Per Cent
6	2nd	Too cold, Submerged, Too sweet, Desirable	50.80 1.80 47.40	3rd	Smooth, Mellow, Resistant, Coarse	57.50 32.70 9.80	2nd	Close, Med. close, Very close	54.00 32.70 13.30	2nd	First Second Third Fourth	19.70 31.10 37.80 11.40
10	1st	Too cold Submerged, Too sweet, Desirable	16.30 8.20 75.50	1st	Smooth, Mellow, Resistant, Soggy	63.90 32.70 3.40	1st	Close Med. close, Very close, Open	37.70 54.00 4.30 4.00	1st	First Second Third Fourth	57.40 24.50 18.10
14	3rd	Too cold, Submerged, Too pronounced, Too warm, Too sweet, Desirable	1.70 14.70 8.30 21.30 54.10	2nd	Smooth Mellow, Resistant, Lacks resistance, Coarse	60.60 18.10 16.40 4.90	3rd	Close, Med. close, Open, Buttery	9.80 45.90 42.60 1.70	3rd	First Second Third Fourth	15.10 24.50 44.20 18.90
18	4th	Too pronounced, Too warm, Too sweet, Desirable	21.30 29.50 34.50 14.70	4th	Smooth, Mellow, Lacks resistance, Soggy, Coarse	26.20 60.60 9.80 3.40	4th	Close, Med. close, Open, Buttery	6.50 18.20 63.90 11.40	4th	First Second Third Fourth	3.20 4.90 19.70 72.20

TABLE 8.—RELATION OF THE SERVING TEMPERATURE TO THE CONSUMER ACCEPTANCE OF CHIP CHOCOLATE ICE CREAM.

Serving Temperatures Degrees F.	Flavor Observations			Body Observations			Texture Observations			Final Observations		
	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Rank	Per Cent
6	3rd	Too cold, Submerged, Desirable	68.90 31.10	3rd	Smooth, Mellow, Resistant, Coarse	24.30 68.90 9.80	3rd	Close Med. close, Very close, Open, Buttery	14.60 13.20 46.80 17.10 8.80	3rd	First Second Third Fourth	7.40 17.10 60.90 14.60
10	1st	Too cold, Submerged, Too pronounced, Desirable,	29.30 9.80 60.90	1st	Smooth, Mellow, Resistant	48.70 51.30	1st	Close, Med. close, Open, Buttery	51.20 34.10 9.80 4.90	1st	First Second Third Fourth	65.90 31.70 2.40 0.00
14	2nd	Pronounced, Too warm, Too sweet, Desirable	9.70 12.30 14.60 63.40	2nd	Smooth, Mellow, Resistant, Lacks resistance	44.10 48.70 7.20	2nd	Close, Med. close, Very close, Open, Buttery	14.60 58.10 15.20 4.90 12.20	2nd	First Second Third Fourth	26.20 46.40 26.80 0.00
18	4th	Pronounced, Too warm, Too sweet, Desirable	19.50 41.50 19.50 19.50	4th	Smooth, Mellow, Lacks resistance, Soggy, Coarse	19.50 44.00 19.50 17.00	4th	Close, Med. close, Open, Buttery	9.70 9.70 56.30 24.30	4th	First Second Third Fourth	0.00 0.00 17.10 82.90

TABLE 9.—RELATION OF THE SERVING TEMPERATURE TO THE CONSUMER ACCEPTANCE OF ORANGE-PINEAPPLE ICE CREAM.

Serving Temperatures Degrees F.	Flavor Observations			Body Observations			Texture Observations			Final Observations		
	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Rank	Per Cent
6	3rd	Too cold, Submerged, Too sweet, Desirable	68.40 9.70 21.70	3rd	Smooth, Mellow, Resistant, Coarse	34.10 59.50 7.40	2nd	Close, Med. close, Very close, Open, Buttery	14.60 24.90 46.30 7.00 7.20	2nd	First Second Third Fourth	31.10 31.70 34.20 3.00
10	1st	Too cold, Submerged, Pronounced, Too sweet, Desirable	17.10 4.90 17.10 60.90	1st	Smooth, Mellow, Resistant, Lacks resistance	36.50 19.50 7.30	1st	Close, Med. close, Very close, Open	51.20 39.00 7.40 2.40	1st	First Second Third Fourth	60.90 34.30 4.30 0.00
14	2nd	Too warm, Too sweet, Desirable	24.30 29.50 46.20	2nd	Smooth, Mellow, Resistant, Lacks resistance, Soggy	36.50 19.50 34.10 9.90	3rd	Close, Med. close, Very close, Open, Buttery	19.50 46.30 4.90 19.50 9.80	3rd	First Second Third Fourth	4.90 29.20 56.20 9.70
18	4th	Pronounced, Too warm, Too sweet, Desirable	17.20 29.20 39.00 14.60	4th	Smooth, Mellow, Lacks resistance, Soggy, Coarse	12.20 65.00 12.20 9.70	4th	Close, Med. close, Open, Buttery	4.90 12.30 58.50 24.30	4th	First Second Third Fourth	0.00 7.30 0.00 92.70

Table 9 shows the placings and observations of orange-pineapple ice cream. This ice cream was pronounced in flavor and was high in sugar content. It was most preferred at a serving temperature of 10 degrees Fahrenheit, 6 degrees Fahrenheit second, 14 degrees Fahrenheit third, and 18 degrees Fahrenheit fourth. The data show that at the higher serving temperatures the flavor was severely criticized by the judges as being too pronounced and too sweet, the body as lacking resistance and the texture as being open.

The flavor and body preference was 10, 14, 6 and 18 degrees Fahrenheit and the texture preference was 10, 6, 14 and 18 degrees Fahrenheit respectively.

Table 10 presents the placings and observations of black walnut ice cream. The serving temperatures at which this ice cream was preferred ranked as follows; 10, 6, 14 and 18 degrees Fahrenheit respectively. The comments indicate that the intensity of flavor in the black walnut ice cream differed somewhat from that in other ice creams in that it was very pronounced at the serving temperature of 10 degrees Fahrenheit, but the ice cream was not severely criticized for being pronounced in flavor at higher serving temperatures as were other ice creams. The serving temperature at which the ice cream was preferred ranked as follows: 10 degrees Fahrenheit first, 6 degrees Fahrenheit second, 14 degrees Fahrenheit third, and 18 degrees Fahrenheit fourth. This indicates that the lower serving temperatures were preferred for black walnut ice cream.

TABLE 10.—RELATION OF THE SERVING TEMPERATURE TO THE CONSUMER ACCEPTANCE OF BLACK WALNUT ICE CREAM.

Serving Temperatures Degrees F.	Flavor Observations			Body Observations			Texture Observations			Final Observations		
	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Rank	Per Cent
6	2nd	Too cold, Submerged, Desirable	63.50 36.50	3rd	Smooth, Mellow, Resistant, Coarse	36.50 56.10 7.40	2nd	Close, Med. close, Very close, Open, Buttery	41.40 19.50 29.30 4.90 4.90	2nd	First Second Third Fourth	19.50 34.10 34.20 12.20
10	1st	Too cold, Submerged, Pronounced, Too sweet, Desirable	7.30 19.50 17.50 65.90	1st	Smooth, Mellow, Resistant, Coarse	48.70 48.70 2.60	1st	Close, Med. close, Very close, Open	48.70 44.00 4.90 2.40	1st	First Second Third Fourth	60.90 36.50 2.60 0.00
14	3rd	Pronounced Too warm, Too sweet, Desirable	21.30 6.20 9.50 62.50	2nd	Smooth, Mellow, Lacks resistance, Soggy	46.30 41.40 12.30	3rd	Close, Med. close, Very close, Open, Buttery	12.20 56.10 4.90 19.50 7.30	3rd	First Second Third Fourth	17.10 24.36 58.60 0.00
18	4th	Pronounced, Too warm, Too sweet, Desirable	31.90 34.10 24.30 9.70	4th	Smooth, Mellow, Lacks resistance, Soggy, Coarse	9.70 41.40 24.60 24.30	4th	Close, Med. close, Open, Buttery	2.40 19.60 56.10 21.90	4th	First Second Third Fourth	0.00 2.40 9.80 87.80

TABLE 11.—RELATION OF THE SERVING TEMPERATURE TO THE CONSUMER ACCEPTANCE OF PINEAPPLE SHERBET.

Serving Temperatures Degrees F.	Flavor Observations			Body Observations			Texture Observations			Final Observations		
	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Rank	Per Cent
6	3rd	Cold, Submerged,	75.00	3rd	Smooth, Mellow, Resistant, Coarse	9.40 75.00 15.60	1st	Close, Med. close, Very close, Open	37.50 25.00 25.00 12.50	3rd	First Second Third	9.40 25.00 65.60
		Pronounced, Too sweet, Desirable	5.10 3.20 18.70									
10	1st	Cold, Submerged,	15.60	1st	Smooth, Mellow, Resistant	50.00 50.00	2nd	Med. close, Very close, Open	24.50 63.00 12.50	1st	First Second Third	65.60 28.20 6.20
		Pronounced, Too sweet, Desirable	12.60 15.60 56.20									
14	2nd	Too warm, Pronounced,	18.00 25.00	2nd	Smooth, Mellow, Resistant, Lacks resistance, Soggy	15.60 25.00 46.90 12.50	3rd	Med. close, Very close, Buttery	37.50 15.70 6.20	2nd	First Second Third	25.00 43.70 31.30
		Too sweet, Desirable	25.00 31.20									

TABLE 12.—RELATION OF THE SERVING TEMPERATURE TO THE CONSUMER ACCEPTANCE OF LIME SHERBET.

Serving Temperatures Degrees F.	Flavor Observations			Body Observations			Texture Observations			Final Observations		
	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Rank	Per Cent
6	2nd	Cold, Submerged, Pronounced, Too sweet, Desirable	50.00 6.10 6.40 37.50	2nd	Smooth, Mellow, Resistant, Coarse	43.70 50.00 6.30	2nd	Close, Med. close, Very close	56.20 28.20 15.60	2nd	First Second Third	12.50 50.00 37.50
10	1st	Cold, Submerged, Pronounced, Too sweet, Desirable	18.70 25.00 9.40 46.90	1st	Smooth, Mellow, Resistant, Lacks resistance	53.10 40.60 6.30	1st	Close, Med. close, Very close, Open	59.40 21.90 12.50 6.20	1st	First Second Third	84.40 15.60 0.00
14	3rd	Pronounced, Too warm, Too sweet, Desirable	37.50 25.00 21.90 15.60	3rd	Smooth, Resistant, Lacks resistance, Soggy, Coarse	38.10 25.00 28.10 12.60 6.20	3rd	Close, Med. close, Open	15.60 40.70 37.50	3rd	First Second Third	3.10 34.40 62.50

Tables 11 and 12 present the placing and observations of pineapple and lime sherbets served at 6, 10 and 14 degrees Fahrenheit. The pineapple sherbet was relatively low in sugar content and mild in flavor, and the judges preferred it served at 10 degrees Fahrenheit first, 14 degrees Fahrenheit second, and 6 degrees Fahrenheit third. The flavor and body was considered most desirable at 10 degrees Fahrenheit and the texture preferred at 6 degrees Fahrenheit.

The lime sherbet was slightly more pronounced in flavor and contained more sugar than the pineapple sherbet and was therefore preferred at a lower serving temperature. The serving temperatures at which the flavor, body, texture and final preference was desired ranked in order as follows: 10, 6 and 14 degrees Fahrenheit.

Tables 13 and 14 shows the consumer preference of orange and raspberry sherbets. The orange sherbet was mild in flavor and was preferred at serving temperatures of 10 degrees Fahrenheit, 6 degrees Fahrenheit second, and 14 degrees Fahrenheit third. The serving temperature as to flavor and body preference ranked 10, 6 and 14 degrees Fahrenheit respectively, while that for the texture was 6, 10 and 14 degrees Fahrenheit.

The flavor was very pronounced and the sugar content was high in the raspberry sherbet. It is clearly indicated by the comments that this sherbet was preferred at the lower serving temperatures. The decided criticisms show that the flavor becomes more pronounced and too sweet at higher serving temperatures. The final preference was at serving temperatures of 6, 10 and 14 degrees Fahrenheit respectively.

TABLE 13.—RELATION OF THE SERVING TEMPERATURE TO THE CONSUMER ACCEPTANCE OF ORANGE SHERBET.

Serving Temperatures Degrees F.	Flavor Observations			Body Observations			Texture Observations			Final Observations		
	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Rank	Per Cent
6	2nd	Too cold, Submerged, Pronounced, Too sweet, Desirable	52.70 2.10 2.20 43.00	2nd	Smooth, Mellow, Resistant, Coarse	61.30 34.40 4.30	1st	Close, Med. close, Very close, Open, Buttery	52.70 34.40 6.40 5.40 1.10	2nd	First Second Third	17.20 52.70 30.10
10	1st	Too cold, Submerged, Pronounced, Too warm, Too sweet, Desirable	18.30 5.40 3.20 8.60 64.50	1st	Smooth, Mellow, Resistant, Lacks resistance	77.40 16.20 6.40	2nd	Close, Med. close, Very close, Open, Buttery	34.40 44.00 4.40 16.10 1.10	1st	First Second Third	60.20 36.50 3.30
14	3rd	Too cold, Submerged, Pronounced, Too warm, Too sweet, Desirable	2.10 29.00 16.30 19.30 33.30	3rd	Smooth, Mellow, Resistant, Lacks resistance, Soggy, Coarse	44.00 17.50 37.60 7.50 3.40	3rd	Close, Med. close, Very close, Open, Buttery	14.10 31.20 1.20 46.00 7.50	3rd	First Second Third	16.10 24.70 59.20

TABLE 14.—RELATION OF THE SERVING TEMPERATURE TO THE CONSUMER ACCEPTANCE OF RASPBERRY SHERBET.

Serving Temperatures Degrees F.	Flavor Observations			Body Observations			Texture Observations			Final Observations		
	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Comments	Per Cent	Prefer- ence	Rank	Per Cent
6	1st	Too cold,	25.00	2nd	Smooth,	53.10	1st	Close,	40.60	1st	First	62.70
		Submerged,	18.70		Mellow,	40.60		Med. close,	9.40			
		Pronounced,	21.90		Resistant,	6.30		Very close,			Third	0.00
		Too sweet,			Lacks resistance			Open	9.40			
10	2nd	Too cold,	12.60	1st	Smooth,	31.20	2nd	Close,	37.50	2nd	First	25.00
		Submerged,	31.20		Mellow,	25.00		Med. close,	34.40			
		Pronounced,	9.40		Lacks resistance,	36.30		Very close,	3.10		Third	0.00
		Warm	31.20		Soggy	3.30		Open	25.00			
		Too sweet,	15.60		Coarse	3.30						
		Desirable										
14	3rd	Pronounced,	43.70	3rd	Smooth,	25.10	3rd	Close,	18.70	3rd	First	0.00
		Warm,	15.60		Mellow,	3.10		Med. close,	28.10			
		Too sweet,	34.40		Resistant,	40.60		Very close,	3.20		Third	100.00
		Desirable	6.30		Lacks resistance,	31.20		Open,	37.60			
					Soggy			Soggy	12.50			

It can be observed that all flavors of ice cream served at 18 degrees Fahrenheit were the most undesirable (Figure 1). The most desirable serving temperature for vanilla ice cream was 14 degrees Fahrenheit, while that temperature was second choice for ice creams

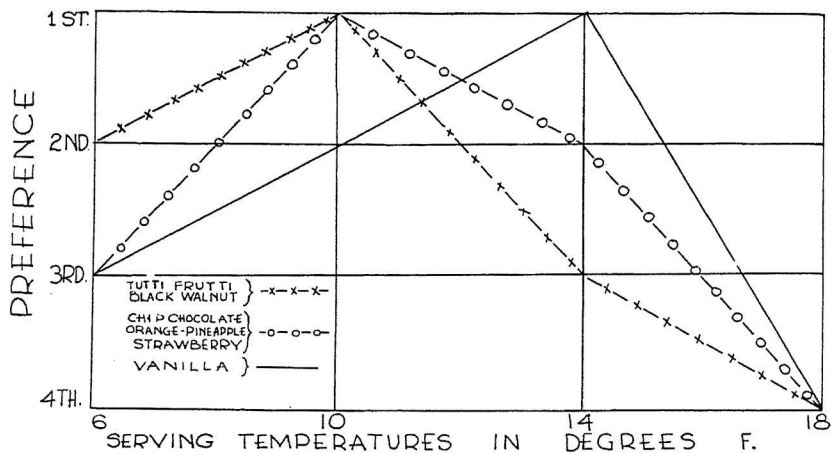


Fig. 1.—Consumer Preference of Ice Creams Served at Four Different Temperatures.

having a higher sugar content and more pronounced flavor, namely, the strawberry, chip-chocolate, chocolate and orange-pineapple ice creams. Third choice was black walnut and tutti-frutti ice creams containing the same amount of sugar but were more pronounced in flavor and were preferred at a lower serving temperature.

The temperatures preferred for tutti-frutti, black walnut, chocolate, strawberry, orange-pineapple and chip-chocolate ice creams was 10 degrees Fahrenheit, however, this temperature was second choice for vanilla ice cream as it was more mild in flavor. Second choice for black walnut and tutti-frutti ice cream was 6 degrees Fahrenheit, although this temperature was third choice for vanilla, chocolate, strawberry, chip-chocolate and orange-pineapple. This indicates that the ice creams having a higher sugar content and pronounced flavor were preferred at a lower temperature as the flavor would be more mild. Ice creams not so pronounced in flavor or as high in sugar content lacked a desirable flavor when served at this low temperature.

Figure 2 shows that the flavor preference for vanilla and strawberry ice cream was at the serving temperature of 14 degrees Fahrenheit. This temperature was second choice for ice creams that

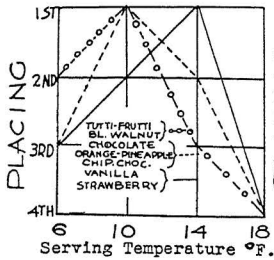


Fig. 2. Flavor Preference

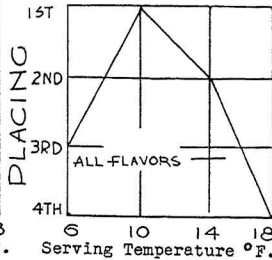


Fig. 3. Body Preference

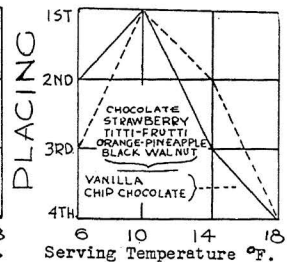


Fig. 4. Texture Preference

Figs. 2, 3, and 4.—The Effect of Four Different Serving Temperatures Upon Flavor, Body, and Texture Preference of Ice Creams.

were somewhat more pronounced in flavor, and third choice for black walnut and tutti-frutti ice creams which were decidedly pronounced in flavor.

The chocolate, orange-pineapple, chip-chocolate, black walnut and tutti-frutti ice creams were preferred at 10 degrees Fahrenheit. This temperature was second choice for the vanilla and strawberry ice creams as they were more mild in flavor.

Second choice for black walnut and tutti-frutti ice creams was at 6 degrees Fahrenheit. The pronounced flavor of these ice creams was more mild and more desirable at the low temperature. This temperature was third choice for all other flavored ice creams which were more mild in flavor, there being a tendency for the flavor to become submerged at the lower temperatures. All ice creams were least desirable in flavor preference at 18 degrees Fahrenheit.

It is of interest to observe that in comparing Figure 2 with Figure 1, the flavor preference and final placing were the same with the exception of a slight variation of the strawberry ice cream. This would indicate that there is a close relationship between flavor preference and consumer acceptance.

Figure 3 shows the body preference of ice creams served at different temperatures and reveals that the body preference at the various temperatures was the same for all flavors of ice cream. The ice creams served at 10 degrees Fahrenheit were considered to have the most desirable body, those at 14 degrees were second, 6 degrees third and 18 degrees fourth. Although the sugar content varied from 14.50 per cent in the vanilla ice cream to 18.00 per cent in the black walnut, it appeared to have very little effect upon the body at the different serving temperatures.

In judging the texture of the ice creams served at different temperatures there was a variation in the opinion of the judges. This variation had a two-fold cause namely, the lack of experience of the judges in observing texture and, secondly, that the effect of the serving temperature upon texture was not very distinct.

It is interesting to note, Figure 4, that the texture preference of all ice creams was at the serving temperature of 10 degrees Fahrenheit. At this temperature most of the judges considered the texture as being close, medium close or very close.

Figure 5 presents the final placings made by the judges of the sherbets served at various temperatures. It appears that the most desirable temperature for all sherbets, with the exception of raspberry, was 10 degrees Fahrenheit. The raspberry sherbet being

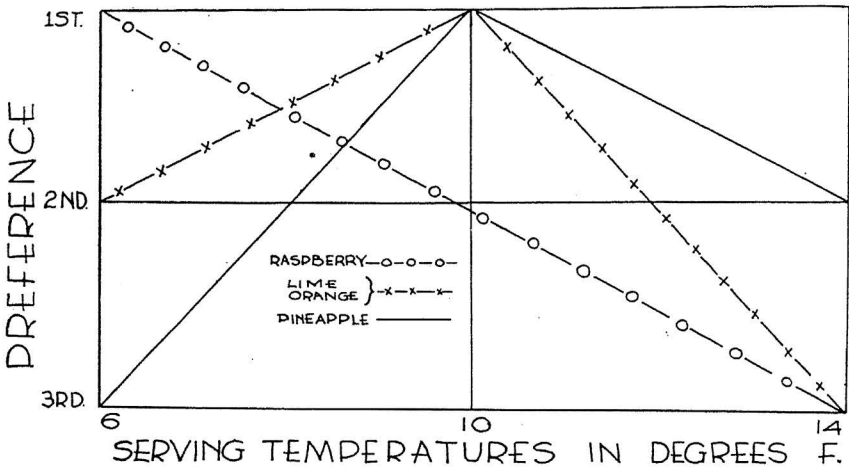


Fig. 5.—Consumer Preference of Sherbets Served at Three Different Temperatures.

higher in sugar content and more pronounced in flavor was preferred at 6 degrees Fahrenheit. At this temperature the lime and orange sherbets being somewhat lower in sugar content and less pronounced in flavor were criticized by some of the judges as being cold and submerged in flavor and resistant in body. The serving temperature of 6 degrees Fahrenheit was least desirable for the pineapple sherbet, as this sherbet was low in sugar content and mild in flavor, while the body was slightly icy and crumbly when served at low temperatures. At 14 degrees Fahrenheit the sherbets were criticized for being sweet and pronounced in flavor, lacking resistance of body, and being open and soggy in texture.

Ice creams served at 6 degrees were criticized by a small percentage of the judges as being open and buttery in texture. However, the vanilla and chip-chocolate ice creams were considered more desirable in texture at 6 degrees than in other flavors studied. Although they were considered less desirable in texture when served at 14 degrees than the other flavors of ice cream judged. This may have been caused by inconsistency of the judges' opinion. At 14 degrees the texture was criticized for being open and buttery. The texture of all ice creams served at 18 degrees Fahrenheit was considered most undesirable and was criticized by a large percentage of the judges as being buttery and open.

The effect of three different serving temperatures upon flavor, body, and texture preference of sherbets are shown in Figures 6, 7 and 8.

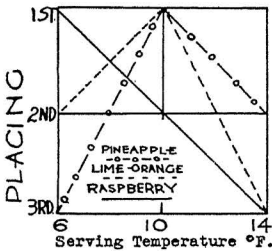


Fig. 6. Flavor Preference

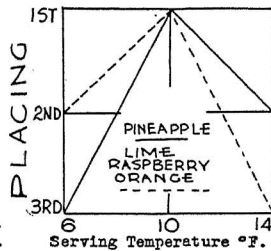


Fig. 7. Body Preference

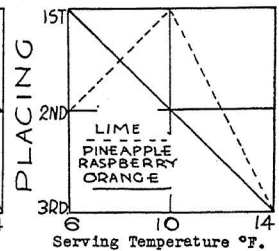


Fig. 8. Texture Preference

Figs. 6, 7, and 8.—The Effect of Three Different Serving Temperatures Upon Flavor, Body, and Texture Preference of Sherbets.

Figure 6 presents the data on the serving temperature of sherbets in relation to flavor preference. As was the case in the ice creams the flavor preference of the sherbets was closely related to the final findings. The flavor at 10 degrees Fahrenheit proved to be the most desirable for all sherbets, except the raspberry. At this temperature the flavor of the raspberry sherbet was criticized for being too sweet, warm and pronounced. A serving temperature of 6 degrees Fahrenheit was the most desirable flavor preference for the raspberry sherbet and second choice for lime and orange sherbets as these sherbets were described as being cold and submerged in flavor at this temperature. The pineapple sherbet, being mild in flavor, was least desirable at the 6 degrees Fahrenheit serving temperature as a large percentage of the judges criticized the flavor for being cold and submerged.

The sherbets served at 14 degrees Fahrenheit were all criticized as being pronounced, too sweet and too warm in flavor.

Figure 7 indicates that the body of all sherbets was preferred at 10 degrees Fahrenheit. At this temperature the greater percentage of the judges considered the body of all sherbets to be smooth and mellow. At 6 degrees Fahrenheit the body of the sherbets was criticized as being resistant and coarse. The pineapple sherbet, being lower in sugar content, was slightly crumbly and icy and was more severely criticized at this temperature.

The body of sherbets served at 18 degrees Fahrenheit was criticized by the judges as being soggy, coarse and lacking in resistance. The pineapple sherbet was not severely criticized at this temperature as the sugar content was lower and the body defects were not as noticeable, indicating that the sugar content is an important factor in determining the serving temperature at which the body of the sherbets is most desirable.

Figure 8 shows that the texture preference of raspberry, pineapple and orange sherbet was at 6 degrees Fahrenheit. In lime sherbet the texture was second choice at this temperature. A large percentage of the judges considered the texture to be close, medium close or very close.

At a serving temperature of 10 degrees Fahrenheit a greater per cent of the judges considered the texture of the sherbets to be open, although the texture of the lime sherbet was preferred at this temperature.

The sherbets served at 14 degrees Fahrenheit were criticized by a large per cent of the judges for having an open, soggy texture.

Table 15 shows more clearly the relation of serving temperature to the intensity of flavor in ice cream and sherbets.

TABLE 15.—RELATION OF SERVING TEMPERATURE TO INTENSITY OF FLAVOR IN DIFFERENT ICE CREAMS AND SHERBETS.

Serving Temperature Degrees Fahrenheit	Intensification of Flavor in Per Cent			
	6	10	14	18
Ice Creams				
Vanilla	0.00	10.00	29.60	84.30
Chocolate	0.90	16.70	43.70	82.30
Strawberry	0.00	12.80	55.30	92.50
Chip-chocolate	0.00	9.70	36.50	80.40
Tutti-frutti	1.60	8.20	44.20	85.20
Orange-Pineapple	9.70	22.00	53.50	85.30
Black Walnut	0.00	26.80	31.70	82.70
Sherbets				
Raspberry	40.60	71.80	93.70	
Lime	12.40	34.40	84.40	
Orange	4.20	26.90	64.40	
Pineapple	6.20	28.10	68.70	

There is a noticeable relationship between the serving temperature and intensity of flavor in ice creams. It can be seen that at the serving temperature of 6 degrees Fahrenheit the judges did not observe intense flavors while at 10 degrees Fahrenheit 10 per cent of the judges recorded intense flavors, 29.60 per cent at 14 degrees and 84.30 per cent described the flavors as intense at 18 degrees Fahrenheit. When judging chocolate ice cream, 0.90 per cent of the judges observed intense flavors at 6 degrees, 16.70 per cent at 10 degrees Fahrenheit, 43.70 per cent at 14 degrees, while 82.80 per cent prescribed the flavor at 18 degrees Fahrenheit as being intense.

The judges did not consider the flavor of strawberry ice cream intense served at 6 degrees Fahrenheit while 12.80 per cent observed intense flavors at 10 degrees, 55.30 per cent at 14 degrees and 92.50 per cent thought the flavor intense at 18 degrees Fahrenheit.

Chip chocolate was not recorded as being intense in flavor when served at 6 degrees, although 9.70 per cent of the judges thought the flavor intense at 10 degrees, 36.50 per cent at 14 degrees and 80.40 per cent at 18 degrees.

When the tutti-frutti ice cream was served at 6 degrees, 1.60 per cent of the judges said the flavor was intense, 8.20 per cent when served at 10 degrees, 44.20 per cent at 14 degrees and 85.20 per cent when served at 18 degrees.

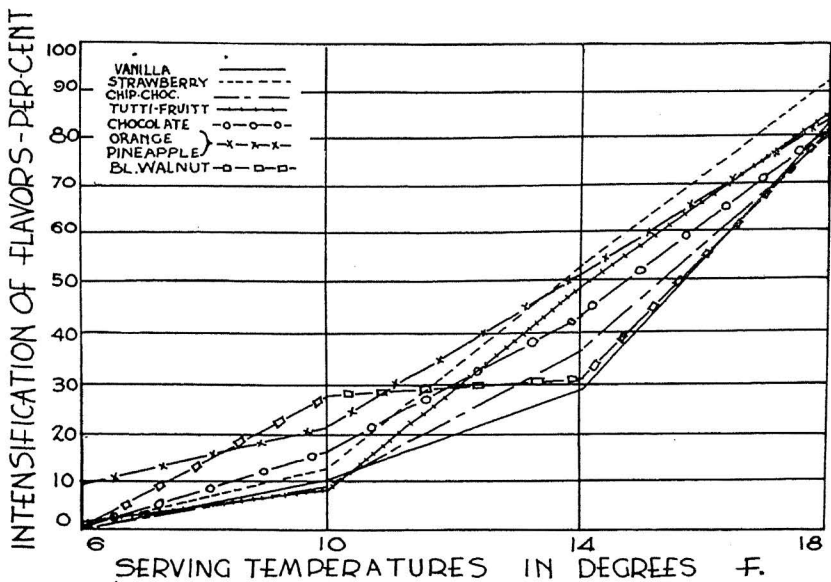


Fig. 9.—Relation of Serving Temperature to Intensity of Flavor in Different Ice Creams.

In orange-pineapple ice cream 9.70 per cent of the judges observed intense flavor when the serving temperature was at 6 degrees, 22.00 per cent when the temperature was 10 degrees, 53.50 per cent at 14 degrees and 85.30 per cent at 18 degrees. The judges did not consider the flavor of black walnut ice cream to be intense when served at 6, however, 26.80 per cent of the judges observed intense flavors at 10 degrees, 31.70 per cent at 14 degrees and 82.70 per cent at 18 degrees Fahrenheit.

Figure 9 shows that there is a decided tendency for the flavor to become more pronounced as the serving temperature is increased from 6 to 18 degrees Fahrenheit when considering all flavors of ice cream it is of interest to observe that from zero to 9.70 per cent of the judges recorded the ice creams served at 6 degrees as being intense flavor, at 10 degrees, 8.20 per cent to 26.80 per cent thought the flavor intense, 29.60 per cent to 55.30 per cent at 14 degrees and at the serving temperature of 18 degrees, 80.40 to 92.50 per cent of the judges considered the flavor intense. These data indicate that within the temperature range of 6 to 18 degrees that as the serving temperature increases the flavor becomes more pronounced.

Figure 10 shows that the greater per cent of the judges considered the flavor more intense when the sherbets were served at 14 degrees Fahrenheit. The raspberry sherbet was considered most pronounced in flavor as 40.60 per cent of the judges thought the flavor intense when served at 6 degrees Fahrenheit, 71.80 per cent when served at 10 degrees Fahrenheit and 93.70 per cent when served at 14 degrees Fahrenheit. When observing the lime sherbet served at 6 degrees Fahrenheit, 12.40 per cent of the judges considered the flavor intense, 34.40 per cent at 10 degrees Fahrenheit and 84.40 per cent at 14 degrees Fahrenheit.

Orange sherbet served at 6, 10, and 14 degrees Fahrenheit was thought to be intense in flavor by 4.20 per cent, 26.90 per cent and 64.60 per cent of the judges respectively.

When pineapple sherbet was judged at 6, 10 and 14 degrees Fahrenheit, the flavor was considered pronounced by 6.20 per cent, 28.10 per cent and 68.70 per cent of the judges respectively.

It should be noted that when considering all flavors of sherbets that from 4.20 to 40.60 per cent of the judges observed pronounced flavors at the serving temperature of 6 degrees Fahrenheit, 24.90 to 71.80 per cent at 10 degrees Fahrenheit. Here again it is interesting to note that the flavor tends to become more pronounced as the serving temperature is increased from 6 to 14 degrees Fahrenheit.

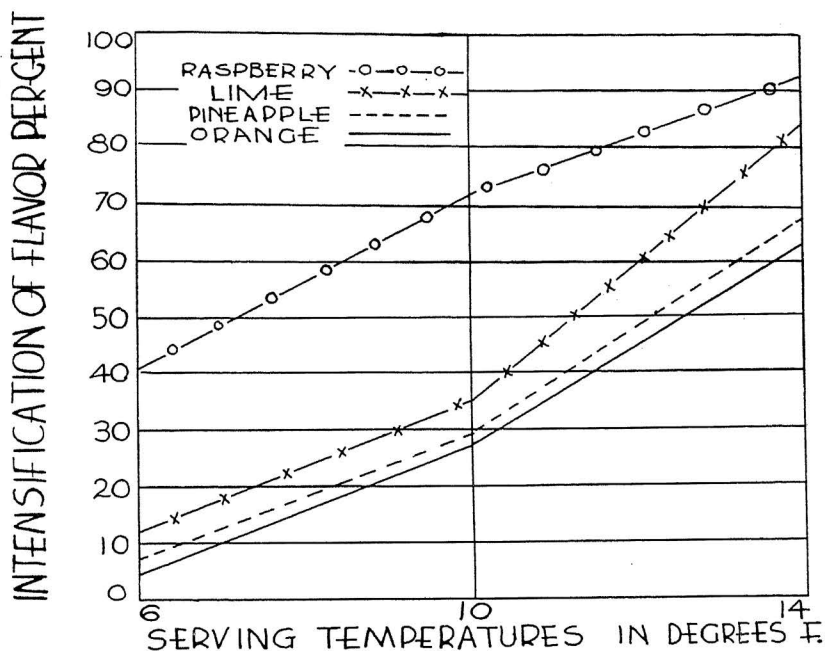


Fig. 10.—Relation of Serving Temperature to Intensity of Flavor of Different Sherbets.

Table 16 shows that ice creams at a serving temperature of 6, 10, 14 and 18 degrees Fahrenheit, when exposed at a temperature of 85 degrees, became undesirable for consumption in average time of 22.7, 22.2, 18.5 and 15.8 minutes, respectively. It seems that serving temperature affects the stability of ice creams very little when temperatures of 6 and 10 degrees Fahrenheit were used, how-

TABLE 16.—THE EFFECT OF SERVING TEMPERATURE ON STABILITY OF ICE CREAMS AND SHERBETS WHEN EXPOSED AT A TEMPERATURE OF 85 DEGREES FAHRENHEIT.

Number of Samples Melted	Serving Temperature Degrees Fahrenheit	Ave. Time for Liquid to Form in Dish Minutes	Ave. Time required to become undesirable Minutes	Ave. Time required for complete Melting Minutes	Ave. Amount Melted in Grams
Ice Creams					
36	6	16.2	22.7	40.0	34.2
	10	15.8	22.2	41.0	35.3
	14	12.8	18.5	35.0	34.6
	18	11.2	15.8	32.1	34.5
Sherbets					
24	6	15.5	26.3	43.5	42.7
	10	15.0	25.2	43.8	44.0
	14	11.7	22.5	41.8	45.0

ever, ice creams served at 14 degrees Fahrenheit became undesirable for consumption approximately four minutes sooner than those served at 6 and 10 degrees Fahrenheit and those served at 18 degrees became undesirable for consumption about seven minutes sooner. This same relationship is noted also in the melting time of the sherbets.

The sherbets served at 6, 10 and 14 degrees when exposed to a temperature of 85 degrees became undesirable for consumption in an average time of 26.3, 25.2, and 22.5 minutes, respectively. Here again it can be seen that there was very little effect of serving temperature on stability at 6 and 10 degrees. However, when the serving temperature of the sherbets was 14 degrees they became undesirable for consumption approximately 4 minutes sooner than those served at lower temperatures.

Figure 11 presenting a visual interpretation of the figures shown in Table 17, shows that there is a direct relation between the size of disher and the stability and consumption values of ice creams when exposed at 85 degrees Fahrenheit.

TABLE 17.—EFFECT OF DISHER SIZE AND STABILITY OF ICE CREAMS. MELTING TIME OF DIFFERENT SIZE DISHER OF VANILLA ICE CREAM. (AVERAGE OF 5 TRIALS).

Size of Disher	Temperature °F.	Time Required for:			Weight in Grams	Temperature Exposed °F.
		Liquid to appear in Minutes	Ice Cream to become Undesirable	Ice Cream to melt entirely M'utes		
12	10	8	38	58	69	85
16	10	9	35	54	57	85
20	10	7	31	48	49	85
24	10	7	24	43	37	85
30	10	6	18	34	26	85

Vanilla ice cream dipped at a serving temperature of 10 degrees with dishers Numbers 30, 24, 20, 16 and 12, became undesirable for consumption in 18, 24, 31, 35 and 38 minutes, respectively. The time required to entirely melt was 34, 43, 48, 54 and 58 minutes for the respective dipper sizes.

The results of this study indicate that the size of the disher has a decided effect upon the time required for vanilla ice cream served at 10 degrees Fahrenheit to become undesirable for consumption and as the disher size increases the ice cream becomes more stable.

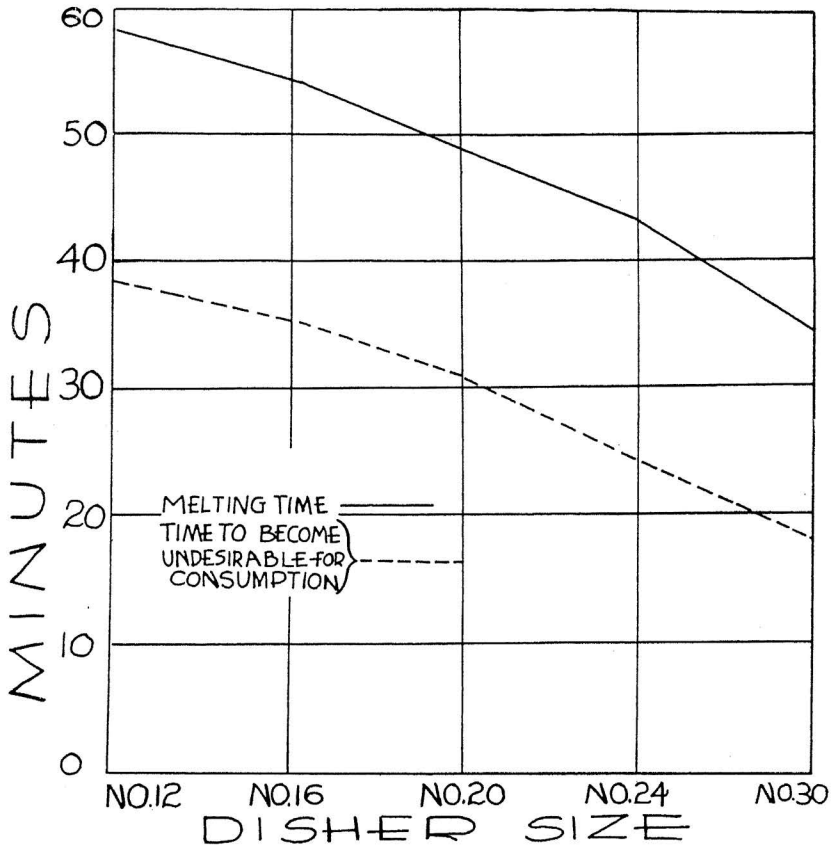


Fig. 11.—Melting Time of Different Size Dishers of Vanilla Ice Cream.

DISCUSSION

The results of this investigation indicate definitely that the serving temperature is a factor of ultimate importance in determining consumer acceptance of ice cream and sherbets. Ice creams served at 6 degrees Fahrenheit were criticized consistently by the judges as having a cold, submerged flavor, resistant body and several of the judges considered the texture to be open and buttery. However, the ice creams high in sugar content and having a decidedly pronounced flavor were less severely criticized at this low temperature than were the more mildly flavored ice creams having a lower sugar content.

At the serving temperature of 10 degrees Fahrenheit all ice creams with the exception of vanilla were considered most desirable for consumption. A large percentage of the judges considered the flavor desirable, the body smooth and mellow and the texture close at this temperature.

Vanilla ice cream, having a lower sugar content and a milder flavor was preferred at a serving temperature of 14 degrees Fahrenheit. Other ice creams served at this temperature, however, were criticized to some extent for being pronounced, sweet and warm in flavor, lacking resistance of body and being open in texture.

All ice creams judged at a temperature of 18 degrees Fahrenheit were considered too pronounced, too warm, and too sweet in flavor by a large percentage of the judges. The body was criticized for lacking resistance, being soggy and coarse, and most of the judges thought the texture open and buttery.

The judges observations on the sherbets examined revealed that the serving temperature preference was similar to that of the ice creams. The sherbets served at 6 degrees Fahrenheit were criticized as having a cold and submerged flavor, resistant body and buttery texture in comparison to those served at 10 and 14 degrees. The raspberry sherbet being very pronounced in flavor and high in sugar content was not severely criticized at this temperature, but was criticized at high temperature being pronounced in flavor and lacking resistance in body.

The texture observations varies to some extent in both the ice creams and sherbets, due to the fact that many of the judges were unable to determine the slight effect that the temperature had upon the texture.

It is interesting to note that in all flavors of sherbets and ice creams the flavor became more intense as the serving temperature increased.

In determining the effect of serving temperature on stability of ice cream and sherbets those samples at the lower temperatures were more firm and remained desirable for consumption for a longer time than did those products of the higher temperature. The time required to become undesirable for consumption was only a few minutes between the ice creams and sherbets served at the lower temperature and those served at the higher temperature it may be considered that this difference is of little significance, as the products served at the higher temperature retained good consumption qualities for reasonably long periods of time.

The disher size seemed to affect the stability of ice creams and sherbets greatly as the ice cream dished with largest sized disher remained desirable for consumption approximately 20 minutes longer than did the ice cream dipped with the smallest size disher. Although the ice cream dipped with the smaller dish remained stable for a reasonable time, this would indicate that ice creams not consumed for some time after being served should be dipped with larger dishers.

CONCLUSIONS

1. Serving temperature is a factor of considerable importance in relation to consumer's acceptance, dipping qualities, and stability of ice creams and sherbets.
2. The most desirable serving temperature for most ice creams and sherbets was 10 degrees Fahrenheit.
3. Ice creams and sherbets having mild flavors and being low in sugar content were preferred at a higher serving temperature than 10 degrees Fahrenheit, while the products having a higher sugar content and more pronounced in flavor were preferred at a lower temperature.
4. The flavor became more pronounced in all ice creams and sherbets as the serving temperature increased from 6 degrees to 18 degrees Fahrenheit.
5. That the sugar content and intensity of the flavor of ice creams and sherbets are factors determining the serving temperatures at which the product is preferred was revealed in this investigation.

6. The effect of serving temperature on body of ice cream and sherbet was revealed in the fact that products served at 6 degrees Fahrenheit were criticized for being too resistant in body while sherbets served at 14 degrees were criticized for lacking resistance and being soggy and coarse in body while at 18 degrees these criticisms were made of the body of the ice creams.

7. It was found that the effect of serving temperature on stability was practically insignificant when ice creams at the serving temperatures of 6, 10, 14 and 18 degrees Fahrenheit were exposed to a temperature of 85 degrees Fahrenheit.

8. Vanilla ice cream dipped at a serving temperature of 10 degrees Fahrenheit becomes more stable as the size of the disher increases.

BIBLIOGRAPHY

1. Reid, W. H. E. 1932 *The Temperature of Serving Ice Cream*. Proc. Inter. Assoc. of Ice Cream Mfgs., Vol. 2, p. 100.
2. Reid, W. H. E. 1933 *What Temperatures Are Best for Dipping?* Ice Cream Field, Vol. 33, p. 22.
3. Reid, W. H. E. 1933 *New Information On Temperatures for the Serving of Ice Cream*. The Ice Cream Trade Journal, Vol. 29, p. 35.
4. Bierman, H. R. 1926 *Effect of Temperature on Dipping*. Ice Cream Review, Vol. 10, p. 126.
5. Turnbow, G. D. and Raffetto, L. A. 1928 *Ice Cream*. John Wiley & Sons, New York.
6. Reid, W. H. E., 1937 *Merchandising of Ice Cream*. (Unpublished). Dairy Department, University of Missouri.