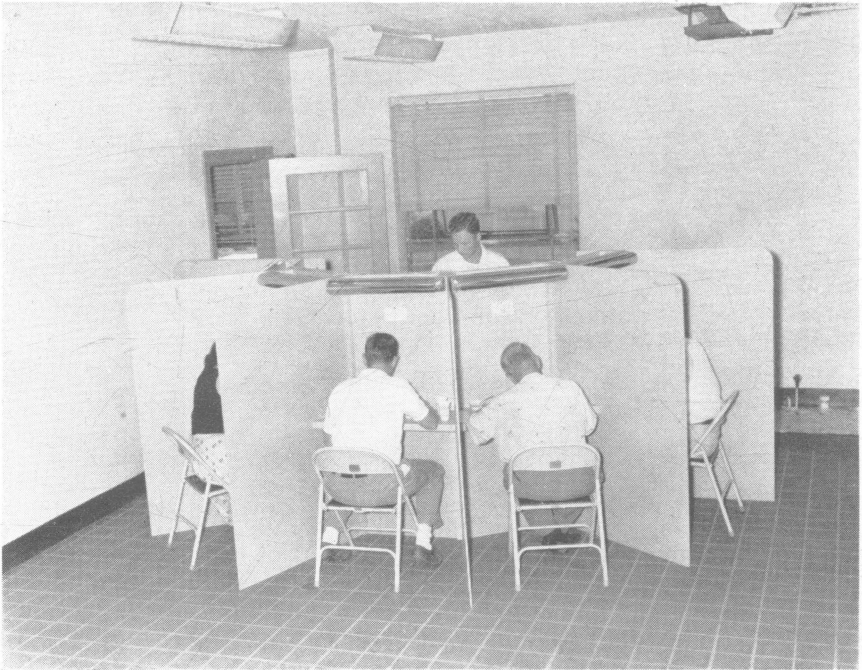


Establishment and Use of a Consumer Panel for the Evaluation of Quality of Foods

WILBUR A. GOULD, JUDITH A. STEPHENS, GILBERT DuVERNAY,
JUDITH FEIL, J. R. GEISMAN, INEZ PRUDENT and RALPH SHERMAN



OHIO AGRICULTURAL
EXPERIMENT STATION

Wooster, Ohio

SELECTED REFERENCES

1. Anderson, R. H. Consumer Demand for Meat. New York Agricultural Experiment Station Bulletin 816 (March 1945).
2. Blakeslee, A. F. Poll of 3121 Persons Shows Wide Variety in Tastes. Science News Letter 35 (4):51 (January 1939).
3. Eppright, E. S. Food Habits and Preferences: A Study of Iowa People of Two Age Groups (Youth and Middle Age). Iowa Agricultural Experiment Research Bulletin 376:874 (1950).
4. Hobson, A., and Scharrs, M. A. Consumer Preferences for Cheese. University of Wisconsin Agricultural Experiment Station Research Bulletin 128 (1935).
5. Laird, D. A. How the Consumer Estimates Quality by Subconscious Sensory Impressions. Journal of Applied Psychology 16: 241 (1932).
6. Laird, D. A., and Breen, W. J. Sex and Age Alterations in Taste Preferences. Journal of the American Dietetic Association 15: 549 (1939).
7. Langwill, K. E. Taste Perception and Taste Preference of the Consumer. Food Technology 3:136 (1949).
8. Levine, P., and Anderson, A. S. Observations on Taste Blindness. Science 75:497 (1931).
9. Stephens, Jane A. Establishment of a Consumer Preference Panel for the Evaluation of Food Products. The Ohio State University: Master's Thesis (unpublished) 1953.
10. Stonoborough, T. H. The Continuous Consumer Panel. Applied Anthropology 1:37 (1942).
11. U. S. Bureau of the Census. U. S. Census of Housing:1950. Vol. V, Block Statistics, Part 42. U. S. Government Printing Office, Washington 25, D. C. 1952.
12. U. S. Bureau of the Census. 1950 Census of Housing Preliminary Reports. Series HC-3, No. 13, Housing Characteristics of the Columbus Ohio Standard Metropolitan Area. U. S. Government Printing Office, Washington, D. C. 1951.
13. U. S. Bureau of the Census. U. S. Census of Population:1950, Vol. II, Characteristics of the Population, Part 35, Ohio, Chapter B. U. S. Government Printing Office, Washington, D. C. 1952.
14. U. S. Department of Agriculture. Problems of Establishing a Consumer Panel in the New York Metropolitan Area. Bureau of Agricultural Economics, Marketing Research Report Number 8 (May 1952).

ESTABLISHMENT AND USE OF A CONSUMER PANEL FOR THE EVALUATION OF QUALITY OF FOODS

**WILBUR A. GOULD, JUDITH A. STEPHENS, GILBERT DuVERNAY,
JUDITH FEIL, J. R. GEISMAN, INEZ PRUDENT and RALPH SHERMAN**

For many years laboratory sensory panels have been used to investigate such food problems as measurement of difference in flavor or acceptability, quantitative estimation of the intensity of component flavors, analysis of complex food flavors into various sensory properties, and the rapid estimation of quality. These panels have in many ways been the spokesmen for the consumer; however, one of the more recent approaches in the field of food evaluation and acceptability is the utilization of consumers for panel members. If it could be confidently stated that there was no difference in the evaluation of products by consumers and experts, or that there was a well defined difference, then research would not be necessary in this area; however, at the present time no such statement can be made.

It is true that many consumer studies have been undertaken and preferences have been determined in relation to many food products, but the answers to the following questions have not been found in the literature: 1) What attributes of quality are important to consumers? 2) Are consumers as critical of the attributes of quality as the grades may indicate? and 3) Small differences in product quality may be discernible to the technologist, but do consumers recognize these differences?

Certainly some of the best attempts that have been made in the field of food research are through the establishment of continuous consumer preference panels by some commercial companies. Although many of these consumer preference panels have been used only for the improvement of company products, some efforts have been made, however, to determine factors influencing consumer preferences. These companies have been faced, however, with the problems involved in maintenance of cooperation and questionnaire validity.

OBJECTIVES

In view of the above considerations, an investigation was undertaken by the Institute of Nutrition and Food Technology at the Ohio State University and the Ohio Agricultural Experiment Station in 1952 to study the problems associated with the establishment and maintenance of a continuous consumer panel which would reflect consumer opinion in the Columbus area and be practical in size as well as readily accessible. The second objective was to determine the preferences and reactions of consumers to a variety of food products varying in specific attributes of quality.

The first phase of this circular is concerned with the techniques used in the establishment of this panel and an evaluation of these techniques in light of the panel composition.

PART I—THE ESTABLISHMENT OF A CONSUMER FOOD PANEL

This consumer preference panel, hereinafter designated as the consumers panel, consisted of 300 families which were selected from an area surrounding The Ohio State University. In the selection of these families, the 1950 census data of Columbus, Ohio, were used as a source of information. The census divides Columbus into 61 census tracts (Figure 1) on the basis of population and natural boundaries. Each tract has a population of from 3,000 to 6,000 people. The census data statistics are given as averages per block and the number of blocks within the tracts varies. The information that was utilized in stratification of the area was the average value and number of home-owned dwelling units per block as well as the average monthly rent and number of rented dwelling units. The area which was selected included ten census tracts (Figures 2 and 3.) Within these tracts were low income blocks on the South and Southeast side, while the central and northern part of the area contained medium and high income blocks. On the basis of the census data it was representative of the city as a whole. The territory covered was irregularly rectangular, approximately 2.25 miles in length and 1.0 mile in width.

The panel was stratified on the basis of income (rental value.)

The stratification on the basis of income within the area was based on the average monthly rental value per block, as the average income per block was not given in the census. Since no rental value was given for those homes which were owned within a block it was necessary to convert the estimated value of the home-owned property to an equivalent rental value and further average this value with the rental value

listed per block in the census. This gave an equivalent rental value per block for the whole. An array was used to divide the whole area into income thirds. The low income blocks included all blocks with an equivalent monthly rent of from \$18.99 to \$37.11. The medium

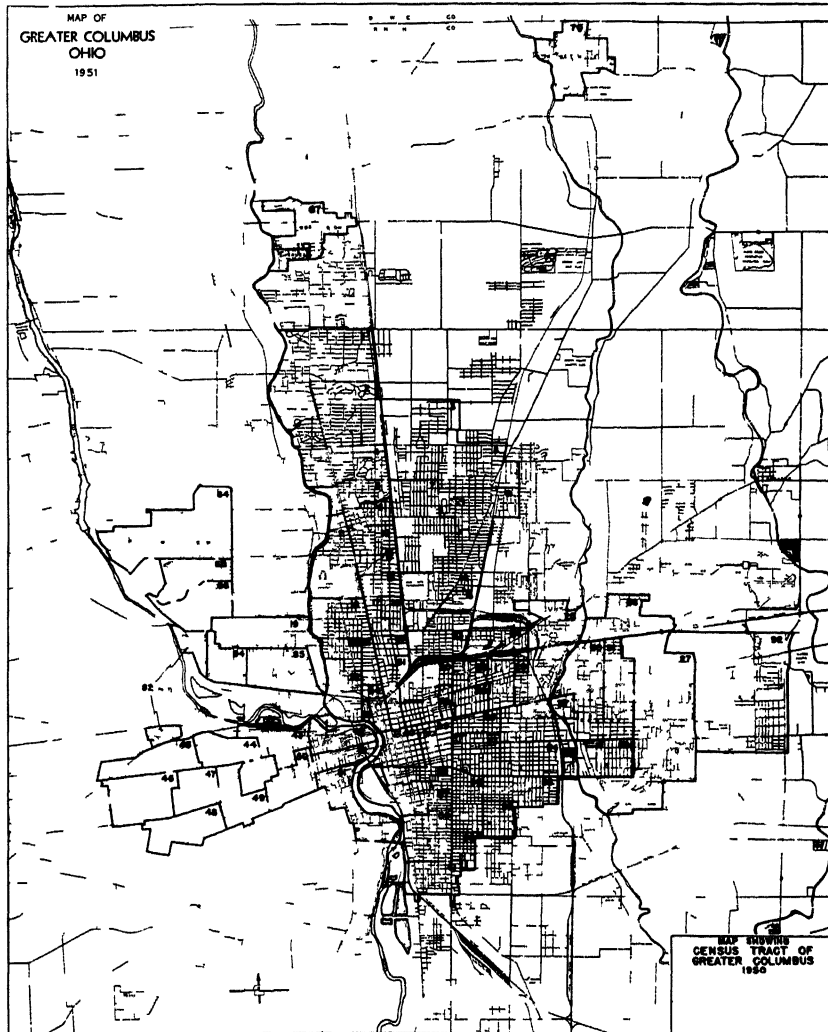


Figure 1.—This map of Columbus, Ohio shows how it is divided into 61 census tracts.

income blocks included all blocks having a rental value of \$37.11 to \$43.71; and the high income blocks included all equivalent rents above \$43.71.

The blocks used for interviewing were drawn at random from the blocks within each tract in the proper income third.

It was necessary to interview the families prior to the delivery of the first samples for the following reasons: 1) to gain fair assurance of their continued cooperation; and 2) to secure data from these families

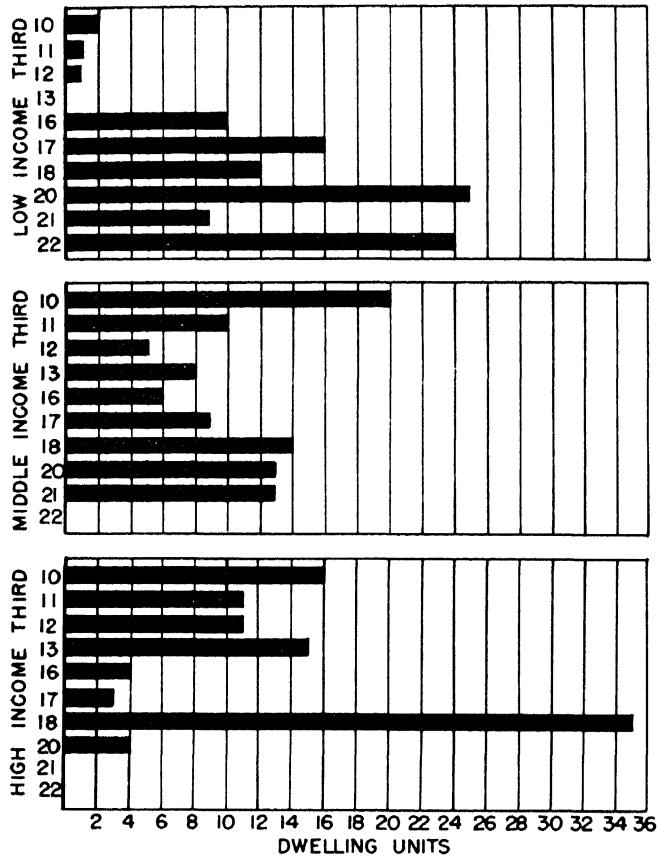


Figure 2.—Number of dwelling units needed for the low, medium, and high thirds within each tract on the basis of income (rental value).

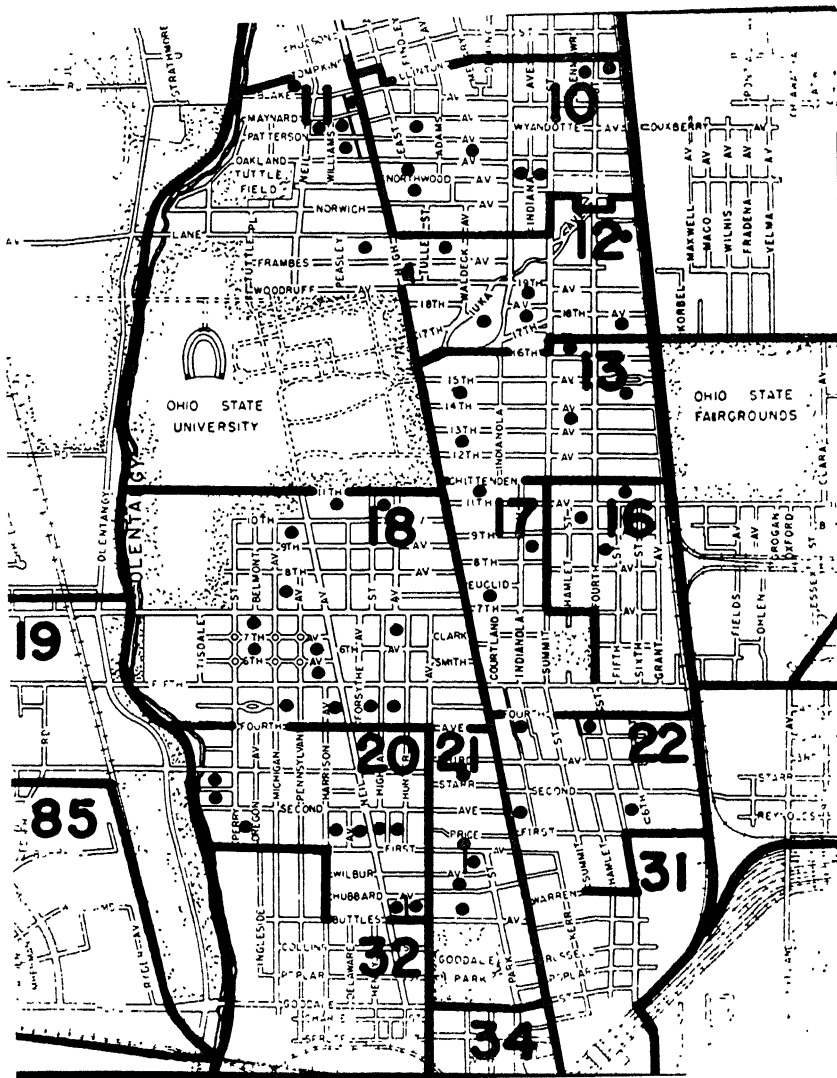


Figure 3.—Map of Columbus showing location of blocks within the tracts from which panel members were obtained.

Figure 4
Consumer Data Card

PERSONAL DATA CARD FOR CONSUMER PANEL

Date _____

Tract _____ Block _____ Dwelling unit in block _____ Description _____

Name head of household _____

Address _____

Race (1) White _____ (2) Negro _____ (3) Other _____

	Name	Relationship to head	Age at last birthday	Education	Occupation
1.	_____	_____	_____	_____	_____
2.	_____	_____	_____	_____	_____
3.	_____	_____	_____	_____	_____
4.	_____	_____	_____	_____	_____
5.	_____	_____	_____	_____	_____
6.	_____	_____	_____	_____	_____
7.	_____	_____	_____	_____	_____
8.	_____	_____	_____	_____	_____
9.	_____	_____	_____	_____	_____
10.	_____	_____	_____	_____	_____

How long have you lived in this dwelling unit? _____

Do you rent your home? _____ Monthly rent _____ Income _____

which could be useful in explanation or interpretation of their preferences (Figure 4). Information concerning family size (Figure 5), ages (Figure 6), extent of education (Figure 7), and income (Figure 8) of the family components was obtained. The percent of home-owned and rented dwelling units of the low, medium, and high income units of the panel (Figure 9) was obtained.

The chosen blocks were canvassed for panel members. This meant that the agents were instructed to contact every household unit within the block. If no member of a household was home on the first call, the agents were requested to drop that unit.

DISCUSSION

On the whole, the sampling design used in the establishment of the panel was satisfactory to give a sample representative of the population of the city of Columbus. This study is not the first one to use the rental value of the census as an index of income and to stratify on that basis. The New York Agricultural Experiment Station in 1945 used this method for selection of their families and they recommended it as a reliable practice (1).

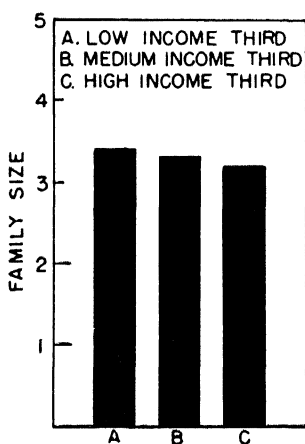


Fig. 5.—Mean family size of low, medium, and high income thirds of panel.

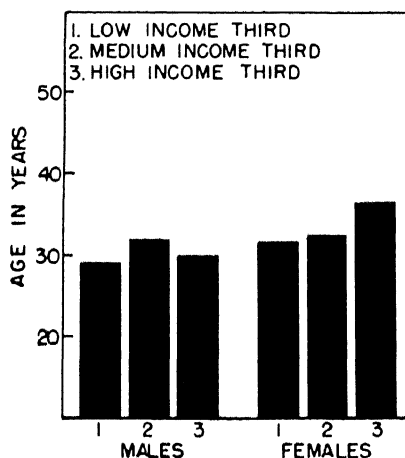


Fig. 6.—Comparison by sex of mean age of low, medium, and high income thirds of panel.

The census figures on the number of dwelling units per block were accurate and the blocks were easy to locate by use of an enlarged map of the area.

There was little difficulty involved in obtaining 300 cooperating members, as was evidenced by the small staff of interviewers employed and the relative short time spent in the field. Since the panel was small in comparison with the size of some of the panels of the commercial companies and no attempt was made to secure the cooperation of a selected group of families, it was anticipated that the time interval spent in the field would be relatively shortened and that a larger staff of interviewers would not have been needed. Actually, it took a period of ten weeks to complete the 300 interviews, using only one interviewer for the whole period, with two assistants available for use in difficult areas.

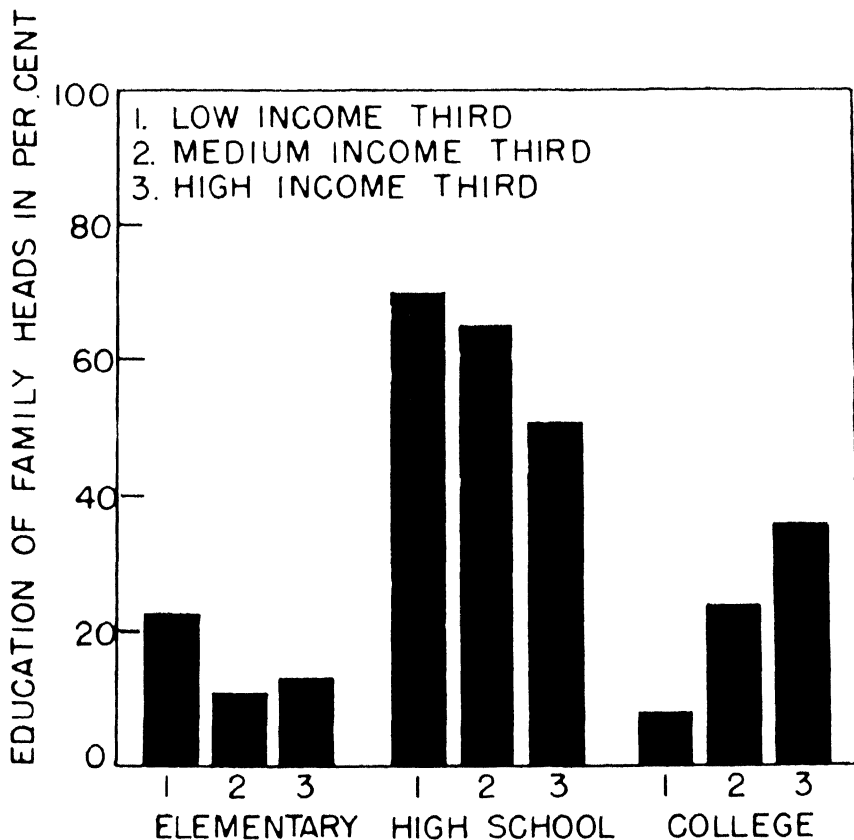


Figure 7.—Percent education of heads of households of low, medium, and high income thirds of panel.

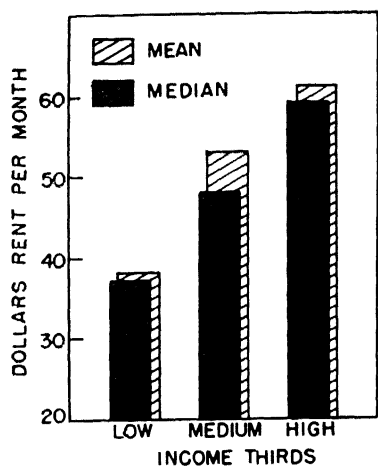


Fig. 8.—Mean and median monthly rent of low, medium, and high income thirds of panel.

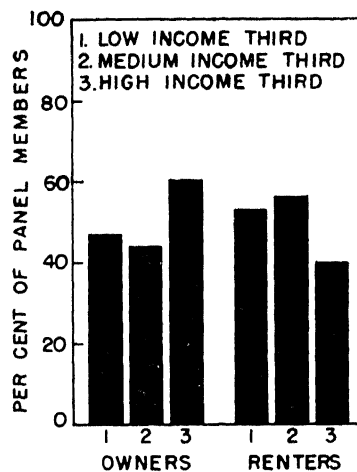


Fig. 9.—Percent of home owned and rented dwelling units of low, medium, and high income thirds of panel.

The 1950 census reports on the characteristics of the population of Ohio (11, 13) and the preliminary reports on the housing characteristics of Columbus (12) contained figures which showed that the area from which the panel members were selected was representative of the entire city of Columbus. The following comparisons were made on the basis of: (1) family size; (2) median age; (3) median income; (4) average monthly rent; and (5) percentage of home-owned and rented dwelling units. The average family size for the panel (3.31) compared favorably with that listed for the average number of persons per household in the population reports of the census (3.24). The average age of the panel was about two years younger than that listed for the Columbus metropolitan area. The median yearly income of the panel was \$800 higher than that listed for the Columbus metropolitan area. Since only the preliminary housing reports were available, less confidence can be placed in the average monthly rental figures and percentages of home-owned and rented dwelling units as given for the Columbus metropolitan area. The rental values indicated that the panel average monthly rent (\$51) was considerably higher than the average monthly rent listed in the census (\$37).

There was little difference in the percentages of home-owned and rented dwelling units as computed for the panel and listed in the census (Table 1).

Since the method used in the selection of the sample included stratification on the basis of income as indicated by the average monthly rental values in the census, it was anticipated that the actual data on family income obtained in interviewing would define three different income groups. There was an interval between the mean salary of the low and medium rental third; however, there was little difference between the medium and high weekly salaries. This lack of correlation between the anticipated and actual income values may not be the result of use of a faulty sampling design or selection of a poor area, but rather may be the result of inaccuracies in the data recorded at the time of the interviewing. It was difficult to obtain reliable data from some people, either because they did not know their own income or it was too variable because increments came from a great many temporary enterprises or jobs. Families who owned their own homes, those who received relief, and those who were retired and lived from savings and investments fell into this category. In those families which had several members working, it was difficult to obtain information on the incomes of all members, and it was also difficult to determine the amount that each wage-earner contributed toward the family income. Housewives among the medium and high income groups were reluctant to give such personal information, which made it impossible to obtain estimates from all 300 families, and sometimes little confidence was placed in the estimates given.

TABLE 1.—Comparison of the Average Size of Family, Median Age, Median Income, Average Monthly Rent, and Percentage of Home-owned and Rented Dwelling Units of the Panel and the Columbus Metropolitan Area

	Population Characteristics					
	Family size	Median age	Median income	Av. mo. rent	% dwell. owned	% dwell. rented
Metropolitan area	3.24	30.9	\$3,093	\$37.00	53	47
Panel	3.31	28.6	\$3,856	\$51.00	51	49

The mean monthly rental values as obtained from interviews did define a low, medium, and high rental third; however, the mean monthly rent did not fall into the range of the original monthly rents listed in the area array for the low and medium third of the panel. The mean monthly rent of the high third fell at the high end of the array. This can be explained, in part, because the panel was obtained in 1952 though the census data was taken in 1950.

A discussion of the problems encountered in interviewing will help to justify the statement that many variables were introduced in the panel composition. This project had definite appeal for certain housewives and did not appeal to others. In general, those women who were interested in food preparation and did not have too many outside activities were the ones who were most interested.

The panel composition was affected by dropping all prospective members who were not at home at the time that the interviewer canvassed the block; it was believed that these people might not be at home later on when samples were delivered and thus some complications in the delivery schedule would ensue. Some families in the lower income areas were quite unresponsive. Possibly they thought the interviewers were bill collectors or salesman. Those who came to the door could not be persuaded to cooperate even though identification cards from the University were carried.

Monday and Friday were not as desirable as week days for interviewing. On the former days, women seemed to be occupied with cleaning and other household duties which led them to protest that they were too busy to be bothered.

The interviewer noted that some women were more willing to cooperate if the interviewer stated that several other people in the block were willing to participate. In canvassing a block, it was far more effective to canvass every other home first and then at a later date return and contact the homes in between. This made the members feel as though they had been especially selected.

SUMMARY

A continuous consumer food preference panel was established in Columbus, Ohio. This panel consisted of three hundred families who were selected at random from blocks within an area no farther than a mile of the University. The sampling design which was adapted in the selection of the families utilized the information in the 1950 block statistics for Columbus which gave the average rental value per block and

the number of dwelling units per block. The chosen area was stratified on the basis of income (rental value) and population trends (number of dwelling units.) Low, medium, and high income thirds were defined and blocks drawn at random were canvassed for interested families. All families were interviewed prior to the delivery of samples.

The sampling design used in the establishment of this panel was adequate. The panel composition compared quite favorably with the general population characteristics which were listed in the census for the City of Columbus. The actual values which were obtained by interviewing for income and monthly rent did not agree with the original data as well as had been expected. The relatively large number of families in the medium and high income thirds who were unable to give adequate estimates of their incomes may have biased the mean and median values which were obtained for the panel as a whole.

PART II—THE USE OF THE CONSUMER FOOD PANEL

The second part of this circular deals with the use of the consumer food panel. The consumer panel has been used to evaluate tomato juice, cream style and whole kernel corn, potato chips, and other foods. Each of the samples for evaluation was manufactured with a known variation in one attribute of quality. The samples were delivered with a questionnaire for each member of the 300 families, 12 years of age or older, along with a self-addressed return envelope. The panels were analyzed by considering the family as a unit, that is, with four members in the family over 12, each member represented one-fourth of the answer for that panel family, etc. Each set of samples¹ was coded by coloring the containers for identification.

On all the questionnaires, the same two questions were asked. (1) "As a rule, do you like the product?" and (2) "How frequently do you use the product? once a week; once every two weeks; once a month; seldom." On the first questionnaire the remaining three or four questions pertained specifically to individual attributes of quality for the product. On the third and subsequent questionnaires, two more questions were added which pertained to the over-all judgment of the

¹For each of the canned commodities, a No. 2 size can (approximately 20-ounces) for each treatment was delivered to each panel member. With potato chips a 4-ounce package of each treatment was used. The samples were submitted to the panel families during the year 1953 and 1954. They were submitted usually at the first of each month except during the summer months when the panel was not used.

product. The final questionnaire adopted includes the two standard questions, four questions which pertain to specific qualities, three which cover an over-all judgment of the products and one which asks which commercial brand of the product the panel member is now using. (Figure 10).

Figure 10 - SAMPLE OF CONSUMER PANEL QUESTIONNAIRE

Date _____ Family No. _____
The Ohio State University
FOOD PANEL QUESTIONNAIRE

Dear Panel Member:

You have been given two samples of whole kernel corn coded by the colors blue and red. Please prepare each sample according to the directions given below and compare the flavor, tenderness, and maturity.

Directions: Heat both cans of corn in separate pans on your stove being careful to remember which is your "blue" corn and which is your "red" corn. Let all of the members of your family taste the corn and those 12 years of age or older fill out the enclosed questionnaires stating their preferences before salt or other ingredients are added. To be a good taster, taste first one and then the other allowing yourself time to judge the qualities of each sample before you taste the next one.

Check in the appropriate space:

- (1) As a rule do you like canned whole kernel corn in your home?
_____yes _____no
- (2) How frequently do you use canned whole kernel corn in your home?
_____once a week _____once every 2 weeks _____once a month _____seldom
- (3) Which sample do you prefer for flavor?
_____red _____blue _____no choice
- (4) Which sample do you prefer for tenderness?
_____blue _____no choice _____red
- (5) Which sample do you prefer for maturity?
_____no choice _____blue _____red
- (6) Considering all things, which sample do you prefer?
_____red _____blue _____no choice
- (7) How does the red sample compare with canned corn you usually use?
_____as good _____better _____not as good
- (8) How does the blue sample compare with canned corn you usually use?
_____as good _____better _____not as good
- (9) Check by using a large "R" for the red sample or a large "B" for the blue sample any of the characteristics indicated below which appear to be typical of the sample:

_____over mature	_____poor flavor
_____good flavor	_____too tender
_____not tender enough	_____too young

(10) What brand of canned corn do you now use? _____
Remarks: _____

Family Member's Signature _____
Position: _____ Husband; _____ Wife; _____ Son; _____ Daughter; _____ Other.

Please fill in your questionnaire promptly and return them in the enclosed self-addressed envelope before February 15. If you have any questions about these samples, please feel free to call us at the University. We hope you enjoy the samples.

Thank you for your kind cooperation.

Sincerely yours,

W. A. Gould, Project Leader

Telephone No. Ax 9-3148, Ext. 434

The results of a consumer survey relative to potato chips and whole kernel corn, made by the Columbus Dispatch² which included the whole city of Columbus, coincided very closely with data secured from the Institute panel. Most of the same brands were named and used by approximately the same percentage of people.

To see whether the panel family was reliable in their response to questions dealing with commodity preference and use, the first two questions, which were the same on every questionnaire, were considered. Only the panel families evaluating the tomato juice, potato chips, and cream style corn samples were used since at least two sets of samples of each would be evaluated to have a comparative response. Only one set of samples of whole kernel corn has been sent out to date.

To determine whether a family was reliable in answering the first question, the questionnaires were checked to see if the same question was answered in the same way every time that it was asked. For example, if a family answered that they liked potato chips on both evaluations (the two potato chip panels), that they did not like tomato juice on both evaluations (the two tomato juice panels), and they liked cream style corn on all evaluations (three panels), the family would be considered 100% reliable. However, if they answered the same for the tomato juice panel and cream style corn panel, but answered "yes" for one potato chip panel and "no" for the other panel, the family would only be 66% reliable. In other words, if they say they like potato chips on the first panel, to be reliable, they should have also checked "yes" on the second panel.

The summarized results of question #1 showed, for the panel as a whole, 62.25% of the families were 100% reliable, 70.68% were at least 66% reliable, 86.35% were at least 50% reliable, 93.57% were at least 33% reliable, while 4.02% were only 0% reliable. (See Figure 11) 18.16 percent of the panel was reliable only 50% or less of the time. These members are consumers and, therefore, they should not be dropped from the panel even though they are not reliable in response to specific questions.

Question #2, "How frequently do you use the product in your home?" was analyzed for reliability by the same method as was used on the first question. However, it was analyzed in two ways. The first way measured reliability when four periods were considered (once a

²Consumer Analysis of the Greater Columbus Market. Compiled by the Columbus Dispatch and the Ohio State Journal. 1953 and 1954 Comparative Report.

RELIABILITY OF PANEL MEMBERS
ANSWERING THE QUESTION —
"AS A RULE, DO YOU LIKE THE PRODUCT ?"

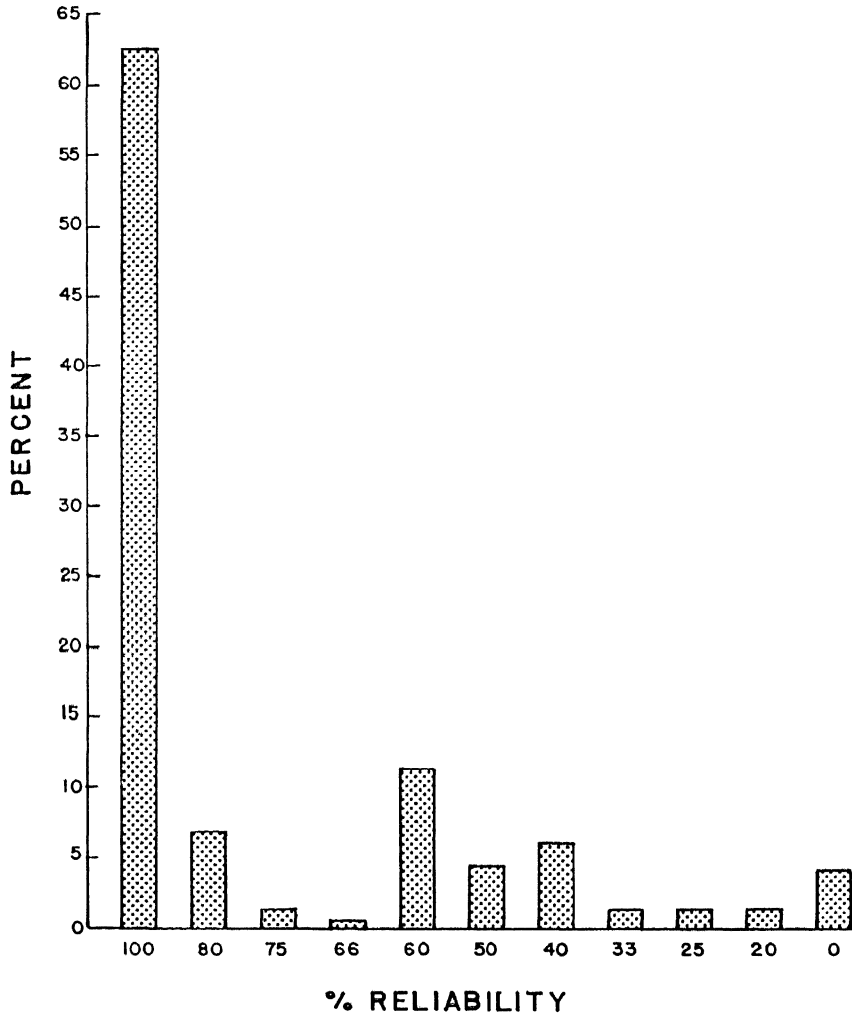


Figure 11

week; twice a month; monthly; seldom;) while the second way used only two periods (once a week and twice a month combined; monthly and seldom combined). To be reliable by the first measure, the family again had to answer the same question with the same answer each time. For example, if they answered on the first panel that they used tomato juice once a week, to be reliable they were expected to answer the same way on the second panel. Or, if they answered on the first panel that they used cream style corn monthly, they were expected to answer the same way on the next two panels to be reliable.

By the second method of analysis, the panel did not have to be as accurate in answering question #2. For example, if a family said they used tomato juice once a week on the first panel, the second panel must be answered either once a week or twice a month to be reliable. If the family answered on the first panel that they used potato chips monthly, to be reliable, they must answer either monthly or seldom on the second panel. If the combination of twice a month and monthly was used, the family was not reliable on this question.

The results for question #2 showed that only 15% of the panel was 100% reliable when four periods were considered whereas 45.5% of the panel was 100% reliable when only the two periods were considered. (See Figure 12). Other results from question #2 were as

RELIABILITY IN % OF PANEL FAMILIES ANSWERING QUESTION 2 —
 "HOW FREQUENTLY DO YOU USE THE PRODUCT IN YOUR HOME?"

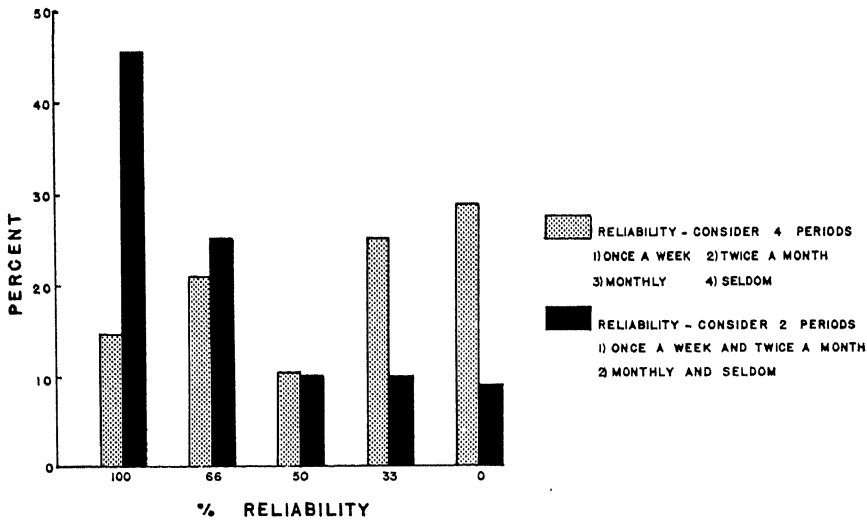


Figure 12

follows: 21% were 66% reliable for 4 periods to 25% for 2 periods; 10% were 50% reliable for both the 2 and 4 periods to 9% for 2 periods. The results show that 80.5% of the panel families were at least 50% reliable when only two periods were considered whereas only 46% of the panel families were at least 50% reliable when the four periods were considered. These data show the panel families have a

**PERCENTAGE OF FAMILIES ANSWERING THE QUESTION
"AS A RULE, DO YOU LIKE THE PRODUCT?"**

- A. - CREAM STYLE CORN**
(AVERAGE OF 3 PANELS)
- B. - TOMATO JUICE**
(AVERAGE OF 2 PANELS)
- C. - POTATO CHIPS**
(AVERAGE OF 2 PANELS)
- D. - WHOLE KERNEL CORN**
(1 PANEL)

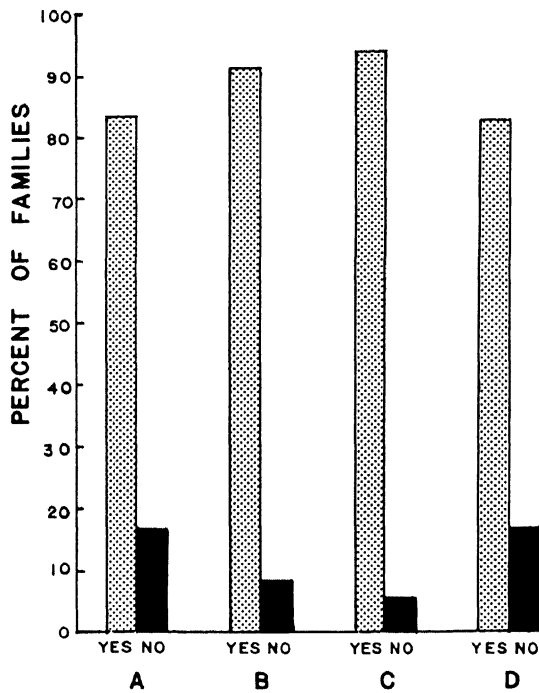


Figure 13

FREQUENCY (%) OF FAMILIES USING TOMATO JUICE,
CREAM STYLE CORN, POTATO CHIPS AND WHOLE
KERNEL CORN IN THEIR HOME. (ACCUMULATIVE)

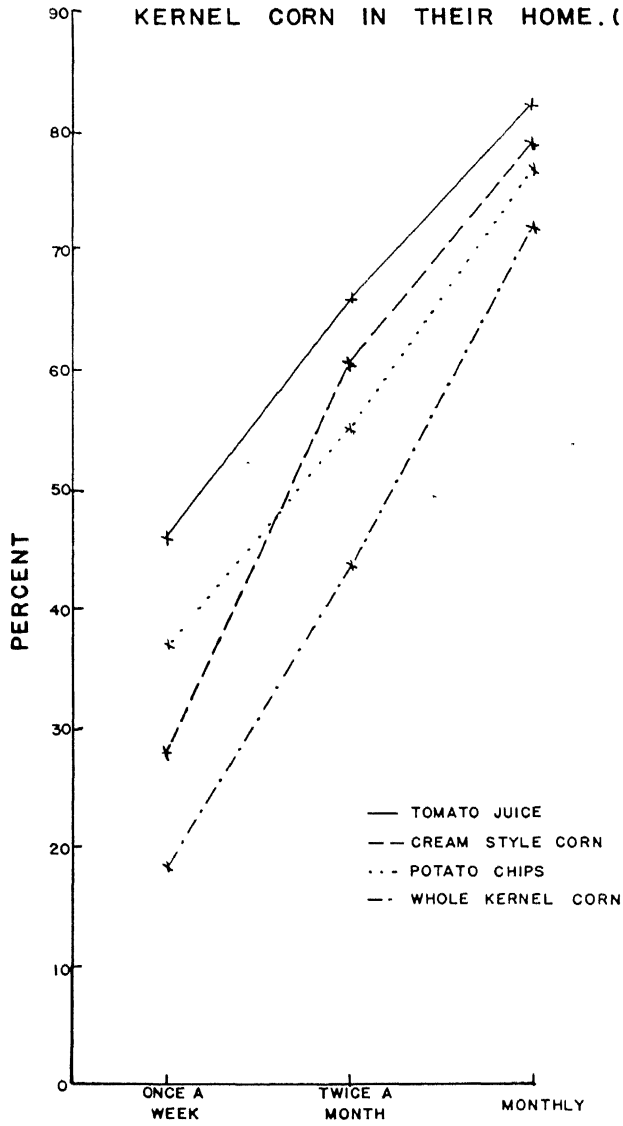


Figure 14

general idea how often they use these products. Furthermore, they can remember how often they use a product over a long period of time but not for a short specific period of time.

Of the samples evaluated (See Figure 13) potato chips were the best liked followed by tomato juice and then the cream style and whole kernel corn which were about the same. However, tomato juice was the most used product followed by cream style corn, potato chips and whole kernel corn (See Figure 14). Sixty-six percent of the panel families on the tomato juice panel, 60% of those on the cream style corn panel, 55% of those on the potato chip panel and 44% of those on the whole kernel corn panel used the respective products at least twice a month. This leaves 34% of the panel families on the tomato juice panel, 40% of those on the cream style corn panel, 45% of those on the potato chip panel and 56% of the panel families on the whole kernel corn panel who use the respective products once a month or seldom. These data indicate a large potential market for these food products.

YELLOW CREAM STYLE CORN—VARIATION IN CONSISTENCY

The first set of cream style corn was yellow cream style corn with the sample coded "yellow"—thin consistency (8.8 Adams consistometer value) and the sample coded "brown"—medium consistency (10.3 Adams consistometer value). In analyzing this sample of cream style corn (See Table 2 and Figure 15), the thin consistency corn sample was preferred³ for flavor, (.05 level) and the medium consistency corn was preferred for consistency (.01 level). When asked to consider all factors, the thin consistency sample was preferred showing that flavor was a more important factor to these consumers than consistency (.05 level).

WHITE CREAM STYLE CORN—VARIATION IN CONSISTENCY

The second set of cream style corn was white cream style corn with the "red" sample of a thin consistency (7.5 Adams consistometer value), and the "green" sample of a thick consistency (12.5 Adams consistometer value). In this set of samples (See Table 2 and Figure 16) the sample with the thin consistency was preferred for flavor (.01 level) and the one with the thick consistency was preferred for consistency (.05 level). When asked to consider all factors, the "red" sample (thin consistency) was chosen again showing that flavor was more important than consistency (.05 level).

³Where applicable, the data were statistically analyzed using the analysis of variance method with the least significant difference (L S D) calculated if the variance was significant.

TABLE 2.—Consumer Evaluation of Cream Style Corn

	Set I* %	Set II† %	Set III‡ %
Percent return of questionnaires	84.0	72.0	93.0
1. As a rule do you like cream style corn?			
Yes	81.6	82.2	85.8
No	18.4	17.8	14.2
LSD .05	28.5	13.1	11.7
.01		30.2	27.1
2. How frequently do you use canned cream style corn in your home?			
Once a week	31.7	26.8	26.5
Twice a month	32.1	29.6	34.9
Once a month	17.7	18.0	16.8
Seldom	18.5	25.6	21.8
LSD .05	8.0	8.1	3.9
.01	11.5	11.6	5.5
3. Which sample tastes better?			
Brown	38.7	Green 32.2	Blue 50.5
Yellow	49.0	Red 55.1	Orange 40.4
No choice	12.3	No choice 12.7	No choice 9.1
LSD .05	5.1	7.3	2.5
.01	8.3	11.7	3.9
4. Which sample has the best consistency?			
Brown	50.2	Green 49.8	Blue 47.2
Yellow	33.0	Red 39.5	Orange 33.4
No choice	16.1	No choice 10.7	No choice 19.4
LSD .05	8.6	7.6	4.3
.01	13.6	12.2	6.9
5. Considering all things, which sample do you prefer?			
Brown	39.8	Green 36.3	Blue 52.4
Yellow	47.3	Red 52.1	Orange 38.2
No choice	12.9	No choice 11.6	No choice 9.4
LSD .05	7.8	14.3	2.1
.01	12.6	23.0	3.9
6: Which sample do you prefer for color?			
			Blue 61.4
			Orange 25.5
			No choice 13.1
LSD .05			5.0
.01			8.0

*Set I Brown sample—10.3 Adams consistometer value (medium consistency)
 Yellow sample— 8.8 Adams consistometer value (thin consistency)

†Set II Green sample—12.5 Adams consistometer value (thick consistency)
 Red sample— 7.5 Adams consistometer value (thin consistency)

‡Set III Blue sample—Yellow corn (Grade A)
 Orange sample—White corn (Grade A)

CONSUMER PANEL PREFERENCES FOR SAMPLES OF CREAM STYLE CORN - I (PERCENT)

YELLOW CORN

B - BROWN - 10.3 ADAMS CONSISTOMETER VALUE

Y - YELLOW - 8.8 ADAMS CONSISTOMETER VALUE

NC - NO CHOICE

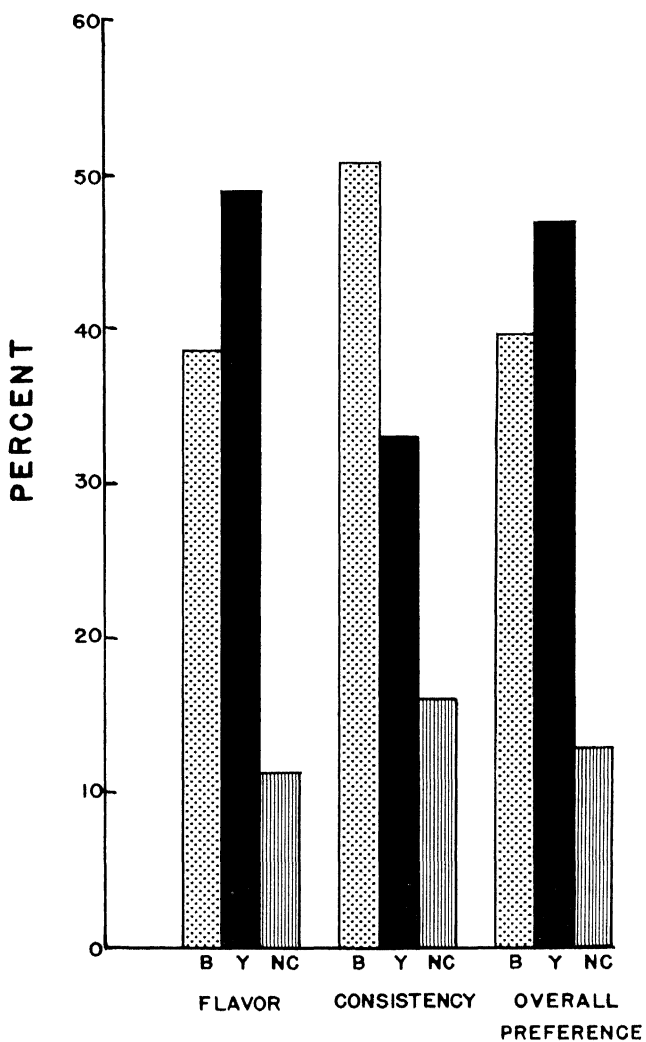


Figure 15

CONSUMER PANEL PREFERENCES FOR
 SAMPLES OF CREAM STYLE CORN-II (PERCENT)

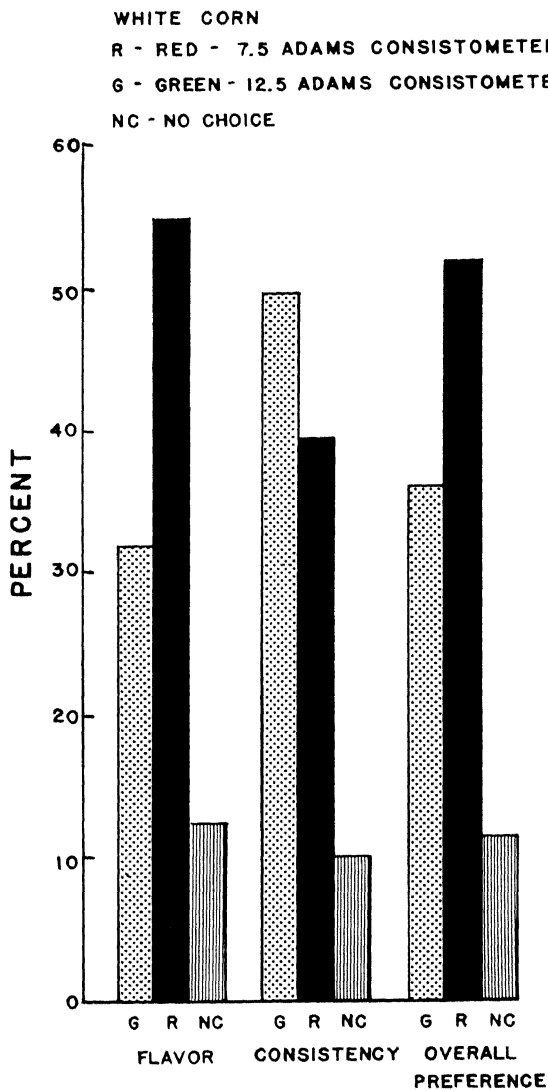


Figure 16

CREAM STYLE CORN—VARIATION IN COLOR—WHITE AND YELLOW

In set three of cream style corn, the samples had the same consistency but varied in color due to the varieties (White and Yellow) used in the manufacture of the cream style corn. Sample "orange" was white corn and sample "blue" was yellow corn. This set of cream style corn samples (See Table 2 and Figure 17) showed that yellow corn was preferred for flavor, consistency, color, and over-all preference in comparison to the white corn (all at .01 level). Therefore, it is evident that the panel preferred the yellow colored corn and appeared to associate the flavor and the consistency with the color of the product. For both the white corn and the yellow corn, 72% of the panel families said the samples were as good or better than the product they now use.

TOMATO JUICE—HOT BREAK COMPARED TO COLD BREAK

The first samples of tomato juice differed by the method of preparation. The sample coded "red" was prepared by the hot-break method and the "green" sample was prepared by the cold-break method. According to the U. S. Grades, there was no difference between the samples for the various attributes of quality. (See Table 3 and Figure 18). The sample prepared by the hot-break method was preferred for consistency (.05 level), flavor (.01 level), and over-all preference (.01 level). There was no significant difference between the samples for color as indicated by consumer preference. The percentage of over-all preference for the hot-break method was almost the same as the percentage for the flavor preference of the hot-break method. This showed that the panel families more closely associated flavor to over-all preference than either of the other attributes of quality—consistency and color.

TOMATO JUICE—VARIATION IN COLOR

The second samples of tomato juice differed in color. The "white" sample was scored 29 points out of a possible 30 (USDA maximum color score for tomato juice) and the "blue" sample was scored 26 points (color scores of both samples determined with the aid of the Hunter Color and Color-Difference Meter). (See Table 3 and Figure 19). The results of the panel families evaluation showed that there was no significant difference in color although the sample which scored 29 points was preferred. The sample which scored 26 points was preferred for consistency (no significant difference) and flavor (.01 level). On over-all preference the 26 point sample was preferred (.01 level) showing again that flavor and consistency are more important factors

**TABLE 3.—Results of Consumer Evaluation of Tomato Juice
(2 sets of samples)**

	Set I† %		Set II‡ %
Percent return of questionnaire	76.0		92.0
1. As a rule do you like tomato juice?			
Yes	91.0		91.9
No	9.0		8.1
LSD .05	14.91		16.0
.01	34.38		37.0
2. How frequently do you use tomato juice in your home?			
Once a week	46.18		50.3
Twice a month	19.6		25.7
Monthly	16.9		24.0
Seldom	17.4		*
LSD .05	9.33		5.2
.01	NS		8.6
3. Which sample has the best color?			
Red	45.3	Blue	31.8
Green	28.8	White	37.8
No choice	25.9	No choice	30.3
LSD .05	NS		NS
4. Which sample has the best consistency?			
Red	45.2	Blue	44.9
Green	34.6	White	35.2
No choice	20.1	No choice	19.9
LSD .05	8.8		10.8
.01	NS		NS
5. Which sample has the best flavor?			
Red	53.6	Blue	53.0
Green	32.0	White	34.5
No choice	14.3	No choice	12.5
LSD .05	10.64		4.3
.01	17.16		6.9
6. Considering all things, which sample do you prefer?			
Red	55.1	Blue	54.6
Green	32.7	White	35.3
No choice	12.3	No choice	10.1
LSD .0.	8.33		9.7
.01	13.42		15.6

*Only three choices on this questionnaire.

†Set I—Red sample—cold break method (Grade A)
Green sample—hot break method (Grade A)

‡Set II—Blue sample—26 points in color
White sample—29 points in color

CONSUMER PANEL PREFERENCES FOR
 SAMPLES OF CREAM STYLE CORN-III (PERCENT)

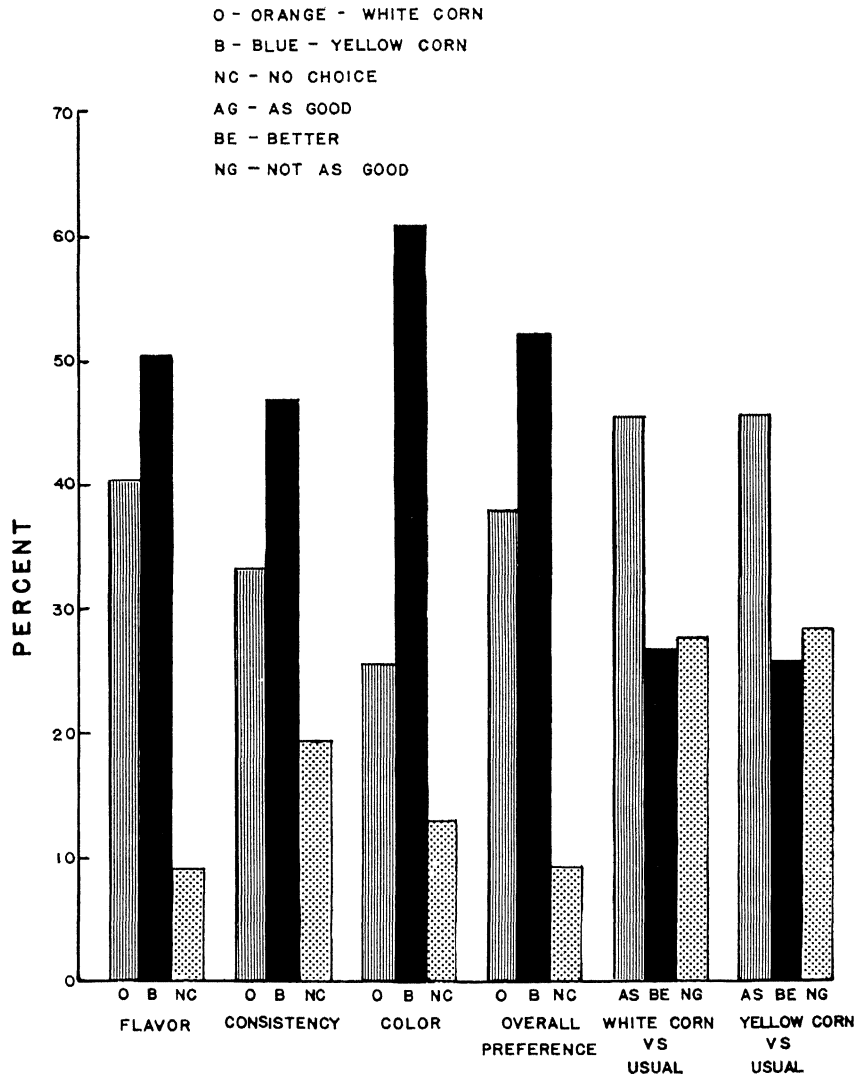
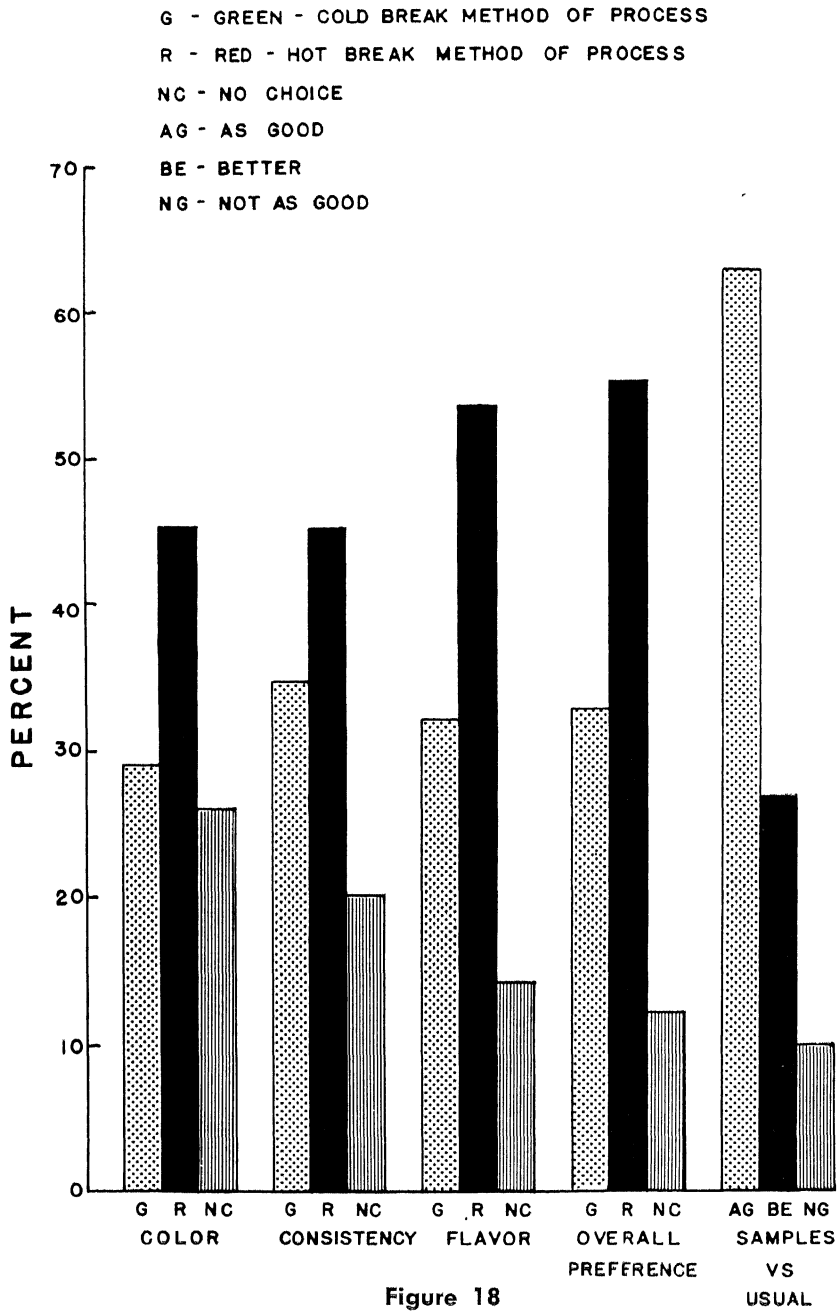


Figure 17

CONSUMER PANEL PREFERENCES FOR SAMPLES OF TOMATO JUICE - I (PERCENT)



CONSUMER PANEL PREFERENCE FOR
 SAMPLES OF TOMATO JUICE -II (PERCENT)

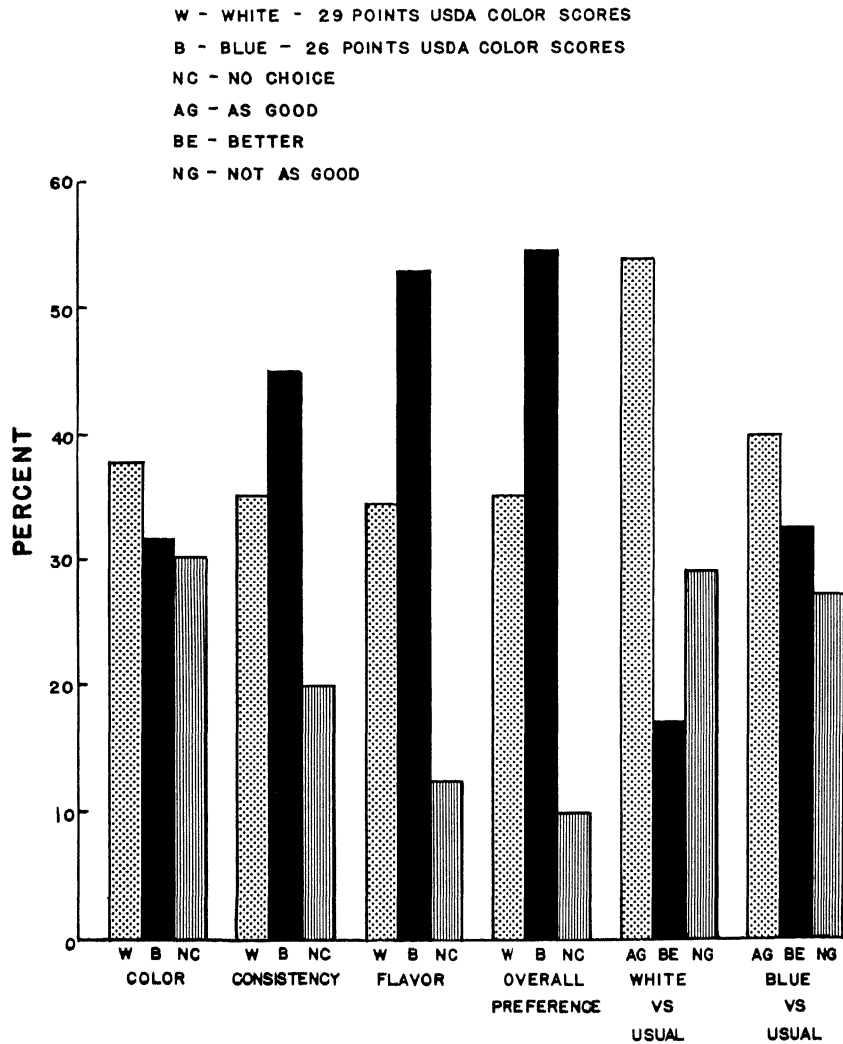


Figure 19

to these consumers than color. The percentage of over-all preference was again almost the same as the percentage of flavor preference showing that the panel families judged the tomato juice more on flavor than on consistency or color. When the samples were compared to the products now used in the home, 71% of these families said the "white" samples (the better color) was as good or better and 72.5% said the "blue" sample (poorer color) was as good or better showing no significant difference between these two samples.

POTATO CHIPS—LIGHT AND DARK COLORED

In the first sample of potato chips, the "red" sample had a lighter color (4) than the "black" sample which was darker (6 as measured on the Coughlin Potato Chip Color Scale). Of these samples (See Table 4 and Figure 20) the light colored sample was preferred for color (.01 level), crispness (.05 level), flavor (.05 level), and over-all preference (.01 level). The panel families preferred the light colored potato chip and then associated the crispness and flavor preference to the color preference. Here again the percentages of over-all preference for the light colored potato chip was almost the same as the flavor preference making the over-all preference more closely associated with flavor than color or crispness. When the samples were compared to the potato chips which were now used in the home, 77% of the panel families said the light colored chips were as good or better and 61% of the panel families said the darker colored chips were as good or better.

POTATO CHIPS—FRIED IN TWO DIFFERENT OILS

In the second set of potato chip samples, the "red" sample was fried in hydrogenated cotton seed oil and the "blue" sample was fried in corn oil (See Table 4 and Figure 21). The sample fried in hydrogenated cottonseed oil was preferred for color (no significant difference) and crispness (.05 level) as compared to those fried in corn oil. There was no preference for flavor and no over-all preference showing that since there was no significant difference between color and flavor, crispness may be a secondary factor to these consumers. Once again the percentage of over-all preference was associated with flavor. There was no preference in flavor and no preference between the samples. In comparing the potato chips to the ones used in the home, 80% of the panel said that both samples were as good or better than what they are now using, again showing no preference between the samples.

**TABLE 4.—Results of Consumer Evaluation of Potato Chips
(2 sets of samples)**

	Set I* %		Set II† %
Percent return of questionnaires	90.0		87.0
1. As a rule, do you like potato chips?			
Yes	93.6		95.0
No	6.4		5.0
LSD .05	15.66		31.42
.01	36.15		NS
2. How frequently do you use potato chips in your home?			
Once a week	30.6		43.5
Twice a month	22.2		14.0
Monthly	24.1		20.1
Seldom	23.1		22.4
LSD .05	NS		3.17
.01	NS		5.18
3. Which sample do you prefer for color?			
Red	61.0	Red	47.4
Black	28.6	Blue	41.7
No choice	10.4	No choice	10.9
LSD .05	11.41		12.94
.01	18.38		NS
4. Which sample do you prefer for crispness?			
Red	45.2	Red	45.0
Black	34.4	Blue	32.5
No choice	20.4	No choice	22.5
LSD .05	9.57		8.00
.01	NS		NS
5. Which sample do you prefer for flavor?			
Red	50.3	Red	43.0
Black	34.2	Blue	43.0
No choice	15.5	No choice	14.0
LSD .05	9.05		6.15
.01	NS		9.90
6. Considering all things, which sample do you prefer?			
Red	52.3	Red	45.0
Black	33.8	Blue	45.5
No choice	13.9	No choice	9.5
LSD .05	7.01		6.18
.01	11.3		9.96

*Set I Red sample—light colored chips (4)
Black sample—dark colored chips (6)

†Set II Red sample—fried in hydrogenated cotton seed oil (color score equal)
Blue sample—fried in corn oil (color score equal)

WHOLE KERNEL CORN—GRADE A COMPARED TO GRADE B

In the only set of whole kernel corn distributed, the “red” sample was graded Grade A and the “blue” sample was graded Grade B according to USDA standards as determined by a USDA grader. Both

**CONSUMER PANEL PREFERENCES FOR
SAMPLES OF POTATO CHIPS - I (PERCENT)**

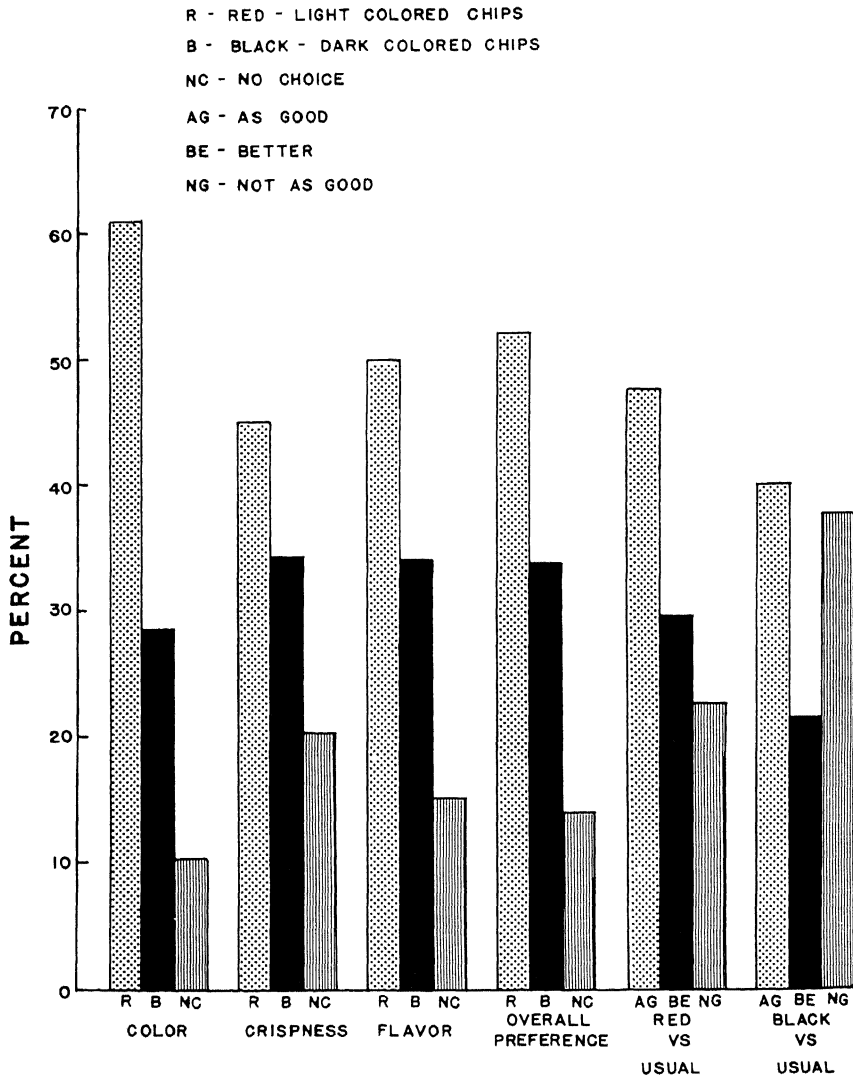


Figure 20

samples were yellow corn and the grade differed only in maturity and tenderness (See Table 5 and Figure 22). Of these samples the Grade A sample was preferred for flavor (.05 level), tenderness (.05 level), maturity (no significant difference), and over-all preference (.05 level).

**CONSUMER PANEL PREFERENCES FOR
SAMPLES OF POTATO CHIPS-II (PERCENT)**

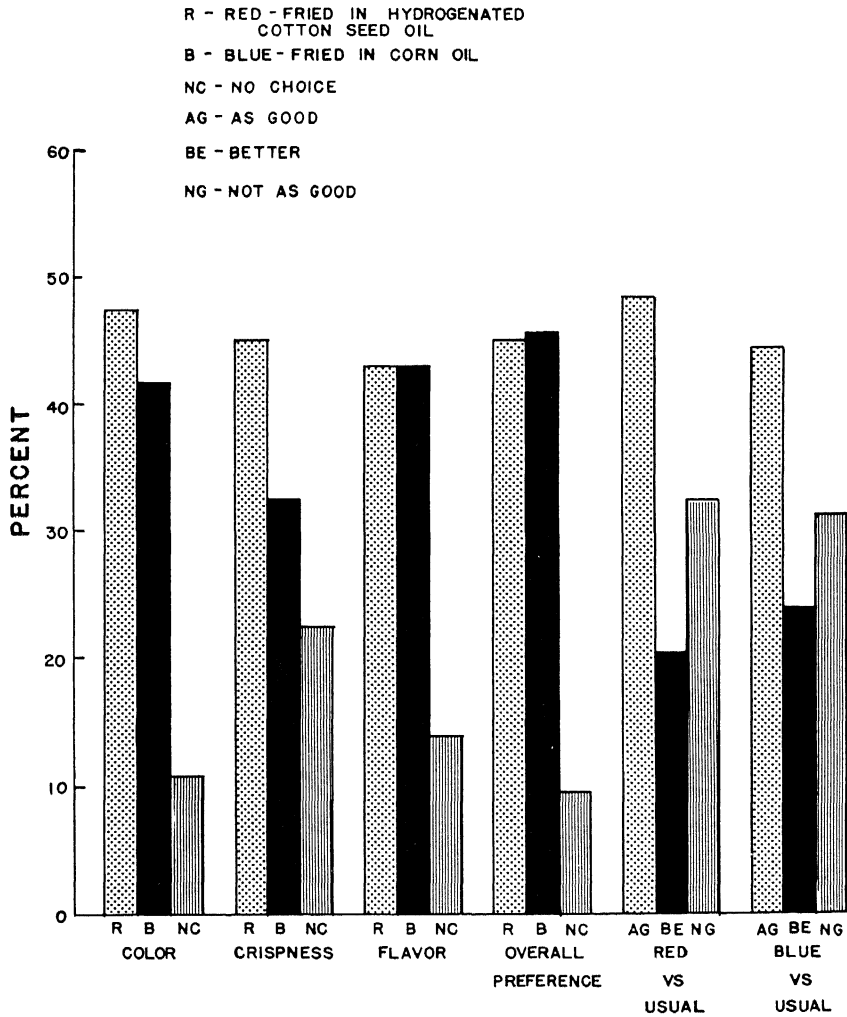


Figure 21

CONSUMER PANEL PREFERENCES FOR
 SAMPLES OF WHOLE KERNEL CORN (PERCENT)

R - RED GRADE A - USDA MATURITY SCORE
 B - BLUE GRADE B - USDA MATURITY SCORE
 NC - NO CHOICE BE - BETTER
 AG - AS GOOD NG - NOT AS GOOD

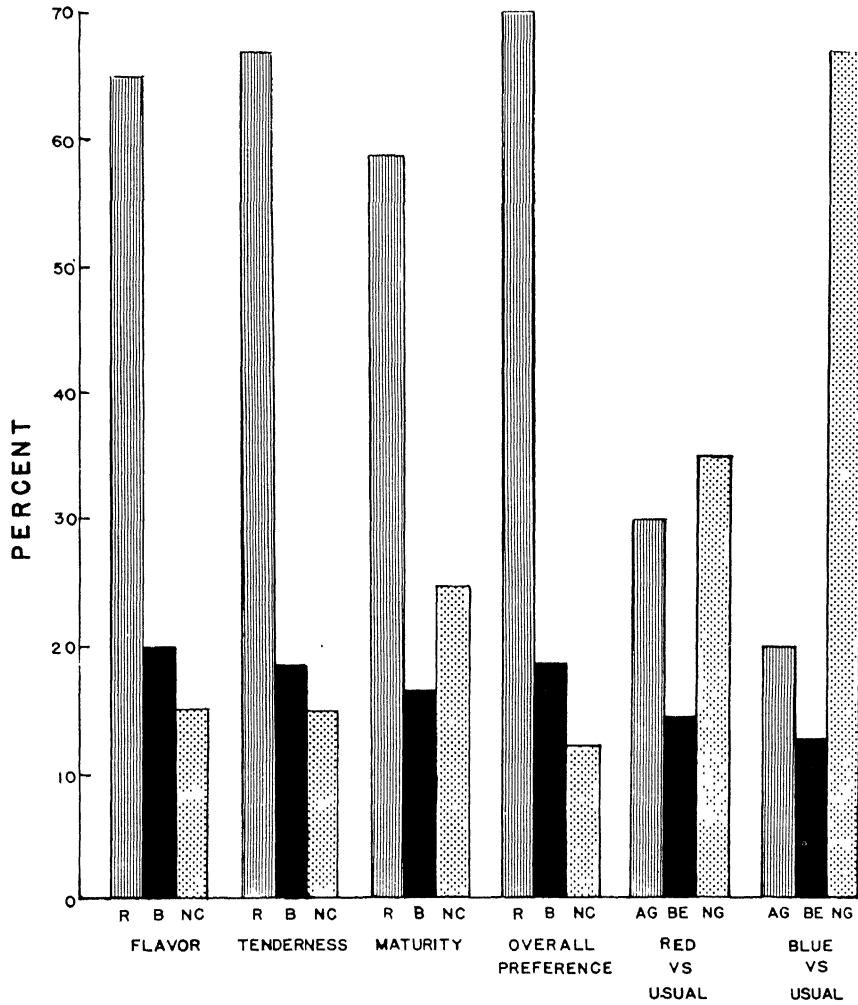


Figure 22

In corn the flavor, tenderness, and maturity were important factors in judging the corn. However, tenderness and flavor preference percentages were more closely associated to the over-all preference of the samples. Even though the panel families definitely showed they preferred the Grade A sample, only 45% of the panel families said that the

TABLE 5.—Results of Consumer Evaluation of Canned Whole Kernel Corn (1 set of samples)

Percent return of questionnaires—83 %

1. As a rule do you like canned whole kernel corn?		Percent
Yes		83.0
No		17.0
LSD .05		17.71
.01		NS
2. How frequently do you use canned whole kernel corn in your home?		
Once a week		28.4
Twice a month		27.4
Monthly		18.4
Seldom		25.8
LSD .05		NS
3. Which sample do you prefer for flavor?		
Red		64.9
Blue		20.1
No choice		15.0
LSD .05		16.10
4. Which sample do you prefer for tenderness?		
Red		66.9
Blue		18.4
No choice		14.7
LSD .05		15.54
.01		NS
5. Which sample do you prefer for maturity?		
Red		58.7
Blue		16.5
No choice		24.8
LSD .05		NS
6. Considering all things, which sample do you prefer?		
Red		70.1
Blue		17.6
No choice		12.3
LSD .05		15.34
.01		NS

Red—Grade A for maturity and tenderness scores.

Blue—Grade B for maturity and tenderness scores.

Grade A sample was as good or better than what they now use and 33% of the panel families said the Grade B was as good or better than what they now use. About 20% of the panel families indicated they preferred frozen corn, cream style corn, home-canned corn, or did not like whole kernel corn, and therefore, did not use it. The low rating of these whole kernel corn samples may have been due to their apparent dislike for canned whole kernel corn.

SUMMARY

The attribute of quality which was most important to the panel and most closely associated with over-all preference of a commodity was flavor. In the first two sets of cream style corn, the panel recognized the differences between the consistencies, but in over-all preference the flavor was more important. In the tomato juice samples differing by the hot and cold break methods, again flavor was the deciding preference factor. In the tomato juice which differed in color, the panel did not recognize the color difference, but again based their preference on flavor. Part of the reason for not recognizing color differences in tomato juice may be due to different types of lighting used in the home, and furthermore, consumers may not be familiar with good tomato juice color.

Color was an important factor in the light and dark colored potato chips. The light chips were preferred and the other attributes of quality appeared to be associated with color. However, the over-all preference was more closely associated with flavor.

In the comparison of the white and yellow cream style corn, the yellow corn was preferred. The over-all preference again was associated with the color of the corn samples.

There was no preference for color or flavor in the potato chips fried in two different oils with the results showing no over-all preference.

Crispness of potato chips and consistency of corn seemed to be recognized by the panel but these were only of secondary importance in over-all preference for these products.

The most important attribute in the preference of whole kernel corn was tenderness and flavor. Maturity was not associated by these consumers with tenderness although in the USDA grades, they are scored as one attribute of quality.