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Consumer Preferences and Their Application to Egg Grading Standards and Marketing Procedures

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This publication reports in part on Department of
Agricultural Economics research project 382, "The Relation
of Egg Quality Criteria to Consumer Acceptability of Eggs."

SUMMARY

A study of consumer preference for shell eggs was conducted in St. Louis, Mo., in 1959. One dozen cartons of eggs were delivered to a sample of 210 households each week for a six-week period. Four cartons consisted of all combinations of two grades and two colors. The grades were Grade A and Grade B, albumen quality. The colors were medium orange and light lemon yellow yolks. Respondents also received one carton each of mixed grades and mixed yolk colors. Rating scores and comments of the respondents about the eggs were used to measure their evaluations of the different classes of eggs.

Grade A eggs were preferred over Grade B, but Grade B eggs were completely satisfactory to more than 50 percent of the respondents. All socio-economic groups preferred Grade A eggs over Grade B. Classifying households on the basis of comments about the stand-up characteristics of the eggs indicated that 73 percent of the respondents did not differentiate between Grade A and Grade B eggs. This indicates that consumers had *similar* preferences for albumen quality of eggs.

Eggs with medium orange colored yolks were preferred over eggs with light lemon colored yolks. Approximately 45 percent of the respondents preferred medium orange colored yolks. The other 55 percent were divided equally between those who preferred darker and those who preferred lighter yolk colors. Yolk preference and grade preference had approximately the same influence on consumers' evaluation of eggs. The results indicate these consumers had *opposing* preferences for egg yolk colors.

Comparison of mean scores for cartons of eggs with mixed grades and comparisons of scores for cartons with mixed yolk colors indicated that albumen quality and yolk color are both more important than uniformity of the attribute itself. The mean scores for the mixed cartons were between the scores of the preferred grade or color and the less preferred grade or color.

The findings on preferences for grade and yolk color indicate the possibility of increasing egg sales by lowering Grade A standards to include the upper one-fourth of Grade B and offering consumers a choice of this new Grade A and also a higher grade (AA). Offering two or more choices of yolk colors with the color identified and stamped on the cartons along with the grade and size labels that now appear would also increase sales.

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INTRODUCTION

Eggs Can Compete More Effectively With Rival Products if Consumers Are Offered a Sufficient Range of Choices to Meet Existing Preferences.

Egg producers and handlers in Missouri are in competition with producers and handlers in other areas and are also in constant rivalry with the producers and handlers of other products that are close substitutes for eggs. Rivalry between eggs and other products provides a strong incentive to the egg industry to seek effective means of influencing the demand for eggs.

Attitudes toward a product partially determine the demand for it, and these attitudes may be made more favorable by making the product more desirable or by making it more convenient to the consumer and by providing favorable information about it. To accomplish a change to a more favorable attitude it may be necessary or expedient to make changes in production and marketing practices and these changes may include the development of new methods of grading, packaging, and labeling eggs.

Egg grading programs have played a major role in establishing orderly conditions in many areas of the egg marketing system. Significant changes have occurred in production and marketing practices since the first federal egg grading activities were initiated in 1925. This program, which is administered by the United States Department of Agriculture in cooperation with various segments of the production and marketing system, has been a positive and creative force in shaping the development of the producing and marketing organizations of the United States. It has facilitated changes in production and marketing practices and has had a coordinating effect on consumers' preferences and on their acceptance of eggs. However, individual tastes and preferences are influenced by many forces. Individual differences, traditions, and personal experiences of the consumers themselves may result in considerable variation in preferences. People are subjected to advertising, brand symbols, and additional merchandising practices that may influence their purchase and use of products and their attitudes toward them. Different personalities frequently respond to the same stimuli in different ways. It is quite possible that conflicts exist between the

quality standards of the grading program and one or more of the forces affecting the product acceptance and preference of a substantial number of consumers. The importance of possible conflict or inadequacy of the grading program is increased by the increased centralization occurring in the egg industry.

Structural Changes in the Egg Industry May Require Changes in Marketing and Merchandising

The individual producing, processing, and marketing units are becoming larger, and a smaller number of firms are engaged in these enterprises. This trend toward fewer but larger units is consistent with the general trend toward larger size in food production and marketing organizations and is expected to continue. Many food retailing organizations are very big, and their procurement and marketing policies are strong influences on producers and handlers. This concentration of decision-making functions into smaller groups of decision makers often leads to greater standardization of products. The fact that production and marketing decisions are made by a few officials of these large integrated organizations may result in consumers being offered a small number of choices in a given product and thus, in few opportunities for them to express preferences for the characteristics they prefer. Decisions about grades, sizes, and other specification standards to be procured and marketed by a particular organization in a market area are made by a very small number of buyers and managers. Thus, the buyers and managers of a few organizations determine the range of choices that are available through the retailing organizations that distribute food to a large segment of consumers.

If consumers that are served by these retail marketing organizations differ among themselves with respect to their attitudes toward eggs and with respect to their preferences for different characteristics of eggs, it is important to the egg industry that these buyers and managers know what their customers' preferences are. It is also important to the egg industry that other decision-makers know as much as possible about consumers' preferences. It is particularly important that egg producers and public officials who set and administer grading standards recognize that individuals have different preferences for certain characteristics of eggs and that they also know something about the distribution and intensity of these differences. The number of choices available to consumers may be just as important in influencing their attitudes toward eggs as measures taken to improve any particular product attribute or to provide favorable information.

OBJECTIVES

The experiment was designed to secure information about consumer preference by distributing eggs with known variation in two specific attributes (albumen height and yolk color) to a group of consumers. This procedure provides an opportunity to gather information about what characteristics are desired in these attributes and also about the variation that will be accepted in them.

The specific objectives of the study are summarized as follows:

1. To determine the influence of variation of two different attributes (Haugh units and yolk color) of eggs on preference and acceptance by household consumers.
2. To find the range or ranges of tolerance for these two attributes.
3. To identify other attributes considered by consumers in evaluating eggs.
4. To reveal relationships that may exist between preference patterns and socio-economic characteristics of households.
5. To make inferences from preference, acceptance and tolerance data for the development of alternative marketing procedures.

METHODOLOGY

The Sample Area Consisted of Portions of St. Louis and St. Louis County.

A sample of 210 households was drawn from the area. Randomizing procedures were used to select 21 census tracts and one starting point in each tract. A systematic procedure was used to contact households from the starting point until a sub-sample of ten cooperators was secured in each tract. Approximately 35 percent of the households at the addresses selected participated in the study. Of the 65 percent who did not participate 20 percent could not be contacted, 22 percent did not qualify and 23 percent refused.

The interviewers were instructed to disqualify a household if only one person resided in it, if the housekeeper was over 65 years old or if the family could not use as many as one dozen eggs each week. Tracts with substantial Negro populations were rejected and no Negro households participated in the study.

Grade Differences Were Produced by Exposing Part of the Eggs to Room Temperatures.

All of the eggs used in the study were produced by the poultry farm of the Poultry Department, University of Missouri. All were candled for blood spots, other defects and albumen quality. The B grade were produced by holding the eggs at room temperature for seven days. The quality of the A grade eggs was maintained by holding them at 33° F. until they were taken to St. Louis for distribution. All of the eggs were refrigerated at 50-55° while they were being held for distribution in St. Louis.

A systematic sample was collected from each class of eggs just before they were taken to St. Louis. This sample was broken out, Haugh units determined for each egg and the mean Haugh units of each class was computed. The A grade eggs had an average score of 80.35. The average score for the B grade eggs was 62.45. The eggs designated grade A were just above the minimum standards for "AA" or "Fancy Fresh" albumen quality. The eggs designated grade B were marginal between low A and high B albumen quality at the time the sample was drawn.¹ Thus a quality difference equal to a full grade existed. Eggs left

¹The average of the Haugh unit scores (62.5) was slightly above the required average 60 units but there were more individual eggs that fell below the minimum of 55 units than is tolerated by minimum grade A standards.

over after the distribution to the households were held in storage in St. Louis at 50-55° F. and brought back to Columbia one week later. These eggs were broken out and scored. The Haugh unit determinations were as follows:

A eggs	80.3
B eggs	50.6

The procedure gave a satisfactory degree of control over the difference in average albumen quality between the two grades of eggs. It also gave confidence in the assumption that the average albumen quality of the better eggs was in the upper range of the A grade standards or the lower range of the AA grade standards at the time of use. The data also supported the assumption that the eggs designated as B eggs were in the upper range of the grade when the consumers used them.

Egg Yolk Colors Were Controlled by Standardizing the Ration of the Hens.

The objectives of the color control were to present the consumer with two different yolk colors,² to determine what portion of the people preferred each color and to measure the relative importance of color preference as compared with the grade preference in determining acceptance of eggs.

The colors were obtained by feeding different rations. The medium yolk was produced in the regular production program with the standard ration used at the Agricultural Experiment Station of the University of Missouri. The medium yolks were quite close to the medium orange color yolk used by Thomsen in a preference study in New York.³ The eggs used in the Columbia pretest showed an average of 48 microgram equivalents of beta carotene.⁴ Those used in the St. Louis study showed 32.5 microgram equivalents.

The eggs with light yolks that were used in the Columbia pretest and in the St. Louis study were each produced by the poultry department of the University of Missouri by changing the ration of the hens. Most of the yellow corn in the ration was replaced by milo and kaffir. The color of those used in the St. Louis study is described as light lemon yellow and is similar to many yolks found in the market. The beta carotene index of the eggs used in the Columbia pretest was 10.5 and of those used in the St. Louis study 14.1.

The colored disks used in the St. Louis study were developed by attempting to create a medium color to match the medium yolk used in the Columbia pretest, and then to make two disks representing uniform gradations of the lighter color and two additional disks representing uniform gradations of the darker

²These different colors might be considered as two intensities of the same color, but they will be referred to as two different colors.

³F. L. Thomsen and Berley Winton, *Consumer Preferences for Egg Yolk Color and Shell Color in New York City*, Agricultural Experiment Station, University of Missouri, Bulletin No. 329 (Columbia: Agricultural Experiment Station, August, 1933), p. 7.

⁴William Howitz, *Official Methods of Analyses of the Association of Official Agricultural Chemists*, 9th edition, Section 16.023 (Washington: Association of Official Agricultural Chemists, 1960), p. 224.

color. The result was a series of five disks ranging from a lighter to a darker color than any egg yolks used in the study.

Egg yolks were then matched to each of these different colored disks. The indexes determined by the beta carotene method were as follows:⁵

Disk 1	6 Micrograms of B carotene
Disk 2	24 Micrograms of B carotene
Disk 3	44 Micrograms of B carotene
Disk 4	74 Micrograms of B carotene
Disk 5	127 Micrograms of B carotene

The tendency for the difference in carotene to increase as the intensity of the color increases has been observed in other objective measurements of subjectively determined gradations.⁶

Disk 3 used in determining color preference in the final interview is darker than the medium colored yolks used in the St. Louis study. However, the medium color yolks received by the households matched in appearance disk 3 better than any of the other disks.

Interviewing Procedure.

The interview work was done by three women who were residents of St. Louis or St. Louis County. Each interviewer was assigned seven census tracts that had been selected by the sampling procedure. Individual assignments were made in the way that appeared likely to minimize distribution problems. The same interviewer made the initial contact, delivered the eggs and collected all of the schedules from each family. The interviewers were carefully instructed concerning the sampling procedure, the use of the schedules and the procedure to be followed in distributing the eggs. The procedures used were checked frequently with each interviewer and samples of each group of schedules were edited as they were turned in. Interviewers were instructed to be very careful not to lead the cooperators to make particular responses to any of the questions.

Schedules Used to Collect Data.

Three types of schedules were used to collect information about the households and their attitudes toward the eggs they received. The initial interview consisted of two types of questions. The first questions were designed to determine whether or not the household qualified for the study. The second set of questions consisted of socio-economic information about the household. The weekly schedules that the cooperators received with each dozen of eggs consisted of a rating scale, questions about how the eggs were used, spaces for like and dislike comments and a section where comparisons could be made with eggs procured from other sources.⁷ The schedule was filled out by the cooperator

⁵ *Ibid.*

⁶ Dorothy Nickerson, *Color Measurement and Its Application to the Grading of Agricultural Products*, Agricultural Marketing Service, United States Department of Agriculture, Miscellaneous Publication 580 (Washington: Government Printing Office, January, 1958), p. 43.

⁷ Schedules available on request.

during the week and was given to the interviewer when the next dozen of eggs was delivered.

The terminating interview asked the respondents to identify and evaluate any variation they noticed in the eggs that had been received over the six-week period. They also were asked additional questions about their experiences and attitudes with regard to the eggs they usually purchased. The schedule contained a section that was designed to obtain additional information about yolk color preference. Each cooperator was shown the set of five colored disks prepared to represent different egg yolk colors and was asked to indicate which color was preferred and which would make an egg unacceptable to them. They were also asked how important it was to them to receive the yolk color they preferred.

All of the schedules were pretested in the Columbia study and minor modifications made to improve the ease of collecting and tabulating the data.

The yolk color preferences expressed in the terminating interview were used as one of the criteria for grouping households in the analysis of rating scores and comments.

PRETEST OF METHODOLOGY

A Sample of University of Missouri Personnel Was Used to Test Procedures.

A pretest was made of the methodology to be used in the St. Louis study. Cooperators were selected from the faculty directory of the University of Missouri by using a table of random numbers to designate pages and names. All single persons and all persons who were members of the Home Economics Department or the Poultry Department were eliminated from the list.

Those selected were asked to receive and use one dozen eggs each week for a period of eight weeks and to evaluate them and furnish information about how they were used. The cooperators were told all the eggs they received would be wholesome and edible but would vary in specific characteristics to meet the purposes of the experiment which was to find out if they preferred some of the eggs to others. They were not told what attribute would be varied. Fifty-two households agreed to participate in the study. Two dropped out after the study was started. Two others were out of town during part of the time and their pattern of use was not complete. The data from these four households were discarded.

The Experiment Was Designed to Test the Effect of Order of Presentation, Grade and Color of Yolk.

The analysis is presented for data from four groups, each consisting of 12 households. Each group received a different order of distribution. The eggs received in week 1 and week 2 were the same for households in the same group. Week 1 was used to standardize distribution and reporting procedure. The data collected this week were not used in the central part of the analysis. In weeks 2 through 5 each group received two different grades of eggs and two different

yolk colors. These were presented to each group in a different order. In weeks 6 and 7 the households received cartons containing mixed grades and mixed yolk colors. In week 6, two groups were given one dozen eggs containing six eggs of Grade A and six of Grade B, both with medium yolk color. The other two groups were given a dozen Grade A eggs containing six eggs of one yolk color and six of another. In week 7 the procedure was repeated but the groups who received mixed colors in week 6 received mixed grades in week 7 and those who received mixed grades in week 6 received mixed colors in week 7. Each household received one carton of mixed grades and one carton of mixed yolk colors. In week 8 each group received a duplication of the package of eggs received in week 2.

Results of the Columbia Pretest Suggest Some Simplifications of Experimental Design.

Results of the analysis showed that these consumers had rather definite procedures for evaluating eggs as indicated by the consistency of ratings over time. There was a significant difference between the mean rating scores of two grades of eggs. There was no significant difference in the scores of four groups of consumers each of whom received a different order of the combinations of two controlled variables, albumen quality, and yolk color, each week for four weeks. There was no significant difference in the average scores of all respondents for the first, second, and eighth week, during which time each respondent in each group received identical dozens of eggs. There was no significant difference between the average scores of mixed cartons of eggs and the average scores of homogeneous cartons of the two kinds of eggs in the mixed cartons. The consumers did not discriminate against the mixing of eggs in cartons.

Simplification of experimental design was indicated by results of the pretest. The St. Louis experiment used only one order of presentation. The distribution of eggs one week for orientation and distribution of the same class of eggs the final week were eliminated. The changed procedure required the handling of only one class of eggs each week and reduced distribution time from eight to six weeks.

ANALYSIS OF RATING SCORES OF RESPONDENTS IN METROPOLITAN ST. LOUIS

Four different classes of eggs were used and evaluated by each household during the first four weeks of the six-week experiment.⁵ Each household received a single dozen of eggs that consisted of one grade and one yolk color each week. All households received the same class of eggs in any given week.

⁵Each of four combinations of two grades and two yolk colors is referred to as a class.

Rating Scores Show That the Grade A Eggs with Medium Colored Yolks Were Preferred.

The score card on which each respondent rated each dozen of eggs provides the central part of the data for the analysis. It provides an index of consumer acceptance and rejection and a quantitative comparison of the preference for one class over the other. The mean scores are near the top of the 0-9 rating scale and appear rather close together (Table 1).

TABLE 1—ORDER OF DISTRIBUTION AND MEAN SCORES BY CLASSES OF EGGS, ST. LOUIS EGG PREFERENCE STUDY, 1959

Week	Class	Mean Score
1	Grade A medium yolks	8.4
2	Grade A light yolks	8.2
3	Grade B medium yolks	8.1
4	Grade B light yolks	7.8
5	Grade A mixed medium and light yolks	8.2
6	Grades A and B mixed with medium yolks	8.3
Average of four classes		8.1

The statistical significance of these differences was examined by analysis of variance of the rating scores.

The households were grouped on the basis of the three interviewers who collected the schedules and questionnaires. This grouping made it possible to compare the data collected by the different interviewers. A three-way analysis of the three groups, two grades and two colors shows that the difference between the mean scores of these groups and classes was statistically significant for both grade and color but was not significantly different for the three interviewers.

The respondents in the sample preferred Grade A eggs to Grade B, and they preferred medium over lighter color yolks. When the means of the scores of each class of eggs were compared to each of the others individually by a two-way factorial analysis of variance, the results were as follows: Grade A medium yolk eggs were preferred over each of the other three combinations of grade and color; the combination of Grade A with light yolk color and Grade B with medium yolk color were equally acceptable; and neither of these means is significantly higher than the mean of Grade B with the light yolks. The mean square values for the comparisons of weeks 2 and 3 with week 4 are larger than in the comparison of these weeks with week 1. However, the error term for the comparisons with week 1 are smaller and the F ratio for the comparison of week 1 with weeks 2 and 3 are significant at the 5 percent level, but week 4 is not significantly different from weeks 2 or 3.

Using the Rating Scale to Indicate Satisfied and Dissatisfied Supports the Results of Analysis of Mean Scores.

In addition to providing a quantitative index of acceptability, the rating scale is divided into three different sections.

1. Completely satisfactory, a rating of nine.
2. Acceptable, but not completely satisfactory, a rating of one through eight.
3. Not acceptable for table use, a rating of zero.

This division of the rating scale provides an opportunity to classify each dozen of eggs as a success or failure on the basis of whether or not the respondent rated it nine (completely satisfactory), or less than nine (not completely satisfactory).

The eggs with Grade A albumen and medium colored yolks were rated nine more frequently than any of the other eggs. The number of respondents who rated each of the four classes of eggs nine was as follows:

- Respondents who rated Grade A medium Yolk 9—140
- Respondents who rated Grade A light yolk 9—114
- Respondents who rated Grade B medium yolk 9—111
- Respondents who rated Grade B light yolk 9—103

The large number of nine rating scores for each of the four kinds of eggs indicates that over half of the households were quite tolerant of variation in grade and yolk color within the range presented in this study. It also gives some understanding of why the mean scores for each of the four classes of eggs are rather close to the top of the scale.

It is of interest to note the way in which the different respondents used the rating scale for the four-week period covering the four classes of eggs. Classification of the respondents on the basis of their use of the rating scale gave the following results:

- Respondents who rated the four classes 9—48
- Respondents who rated part of the classes 9 and part less than 9—131
- Respondents who rated all classes less than 9—22
- Respondents who rated one class 0—1

Comparing the ratios of success and failure for each class of eggs is an index of the relative acceptance of each class by the respondents in the study. The ratios were as follows:

A grade medium color yolk	140 : 61
A grade light color yolk	114 : 87
B grade medium color yolk	111 : 90
B grade light color yolk	103 : 98

When the differences between these ratios were tested for statistical significance by analysis of chi-square, the results showed that the Grade A medium yolk eggs were preferred over the others and there was no significant difference in the number of respondents who accepted the other three classes.

The chi-square analysis of ratings on the basis of nine scores and less than nine scores brings out the importance of the frequency of the nine scores. The results raise a question as to how much of the significance in the analysis of variance is associated with this difference in the frequency of the nine scores. Analysis of variance of the difference between the means of scores for all scores below nine for the four different classes of eggs showed no significant differences between any of the four mean scores. This comparison of results from three

methods of analysis showed that the greater part of the difference between the means of the rating scores was associated with the difference in frequency of scores of nine.

Analysis of Number of Favorable and Unfavorable Comments for Four Different Classes of Eggs Supports Results of Analysis of Rating Scores.

The weekly score card that contained the 0-9 rating scale also provided an opportunity for the respondent to comment on the eggs. The responses consisted of like and dislike comments and comparisons with eggs from other sources. The number of like and dislike comments differed for the various classes of eggs received. An analysis of the responses consists of testing significance between the difference in the number of like and dislike comments for the four classes of eggs (Figure 1).

Fig. 1—Number of Like and Dislike Comments for Four Classes of Eggs (St. Louis egg study, 1959).

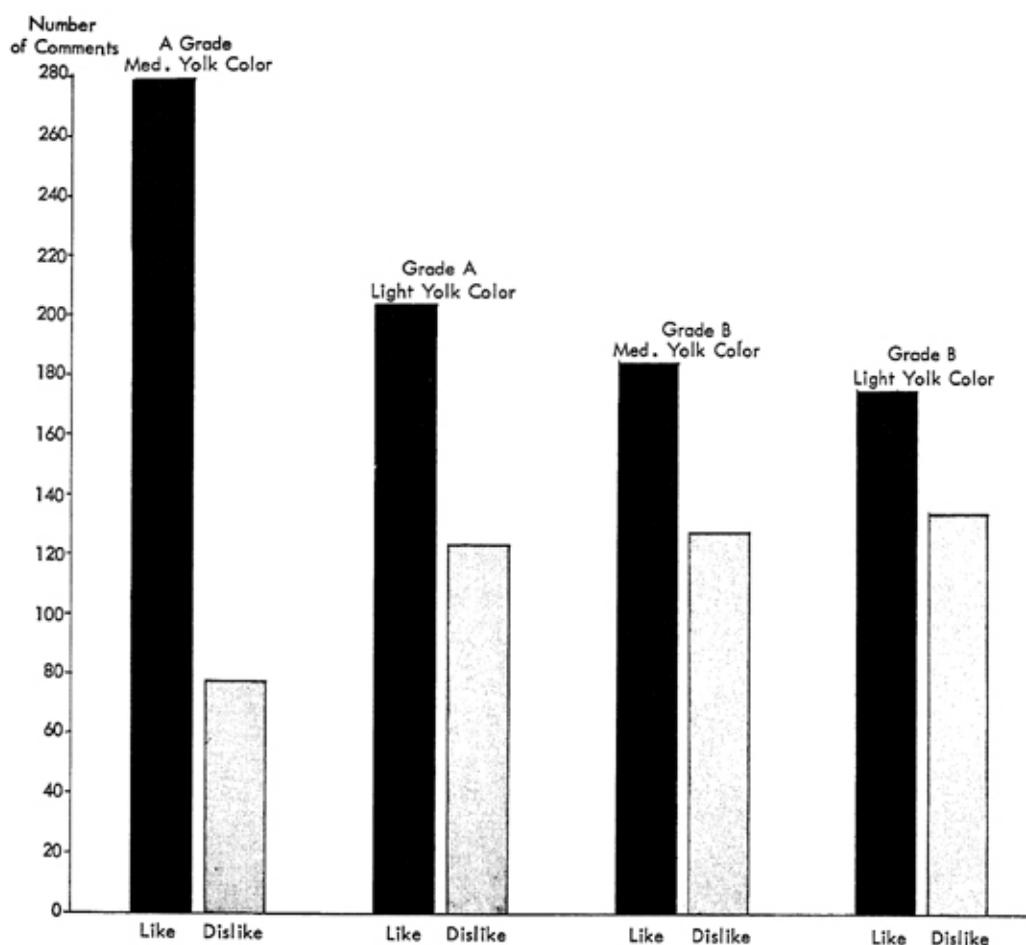


Fig. 2—Number of Favorable and Unfavorable Comparisons for the Four Classes of Eggs. With Eggs Received the Same Week from the Regular Source

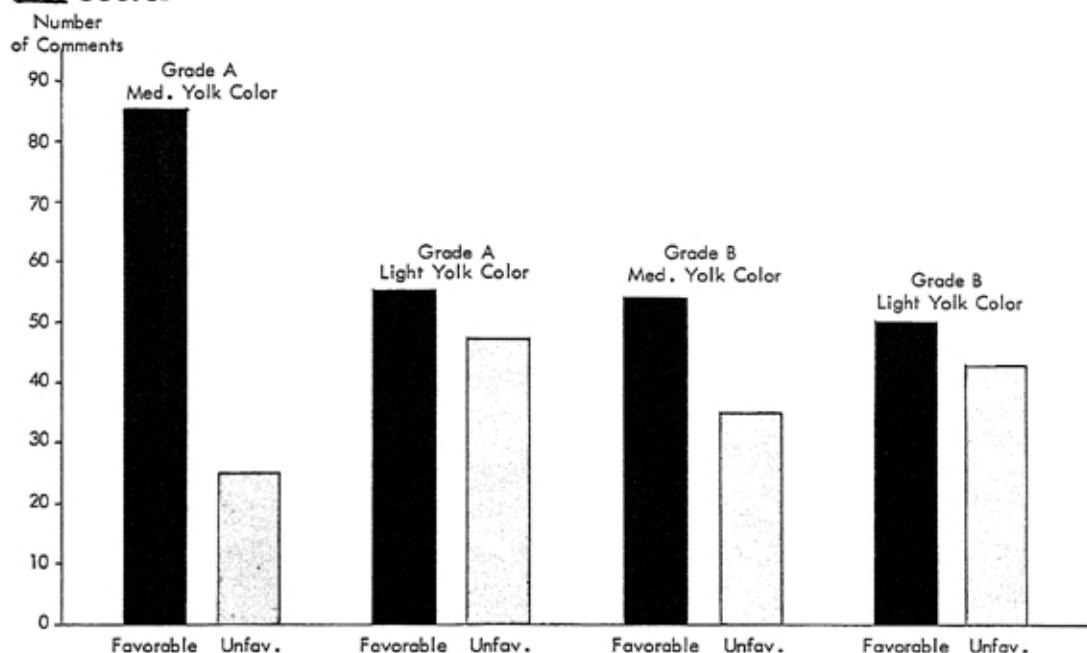
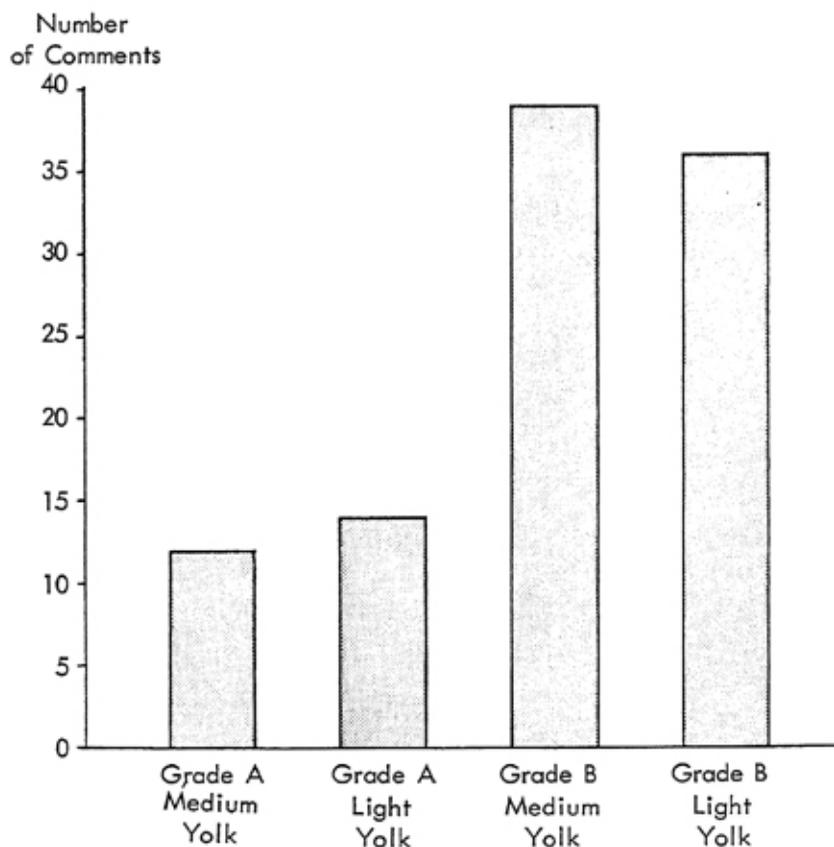


Fig. 3—Number of Dislike Comments on Stand-Up for Four Classes of Eggs by Respondents Who Rated Them Less Than Nine.

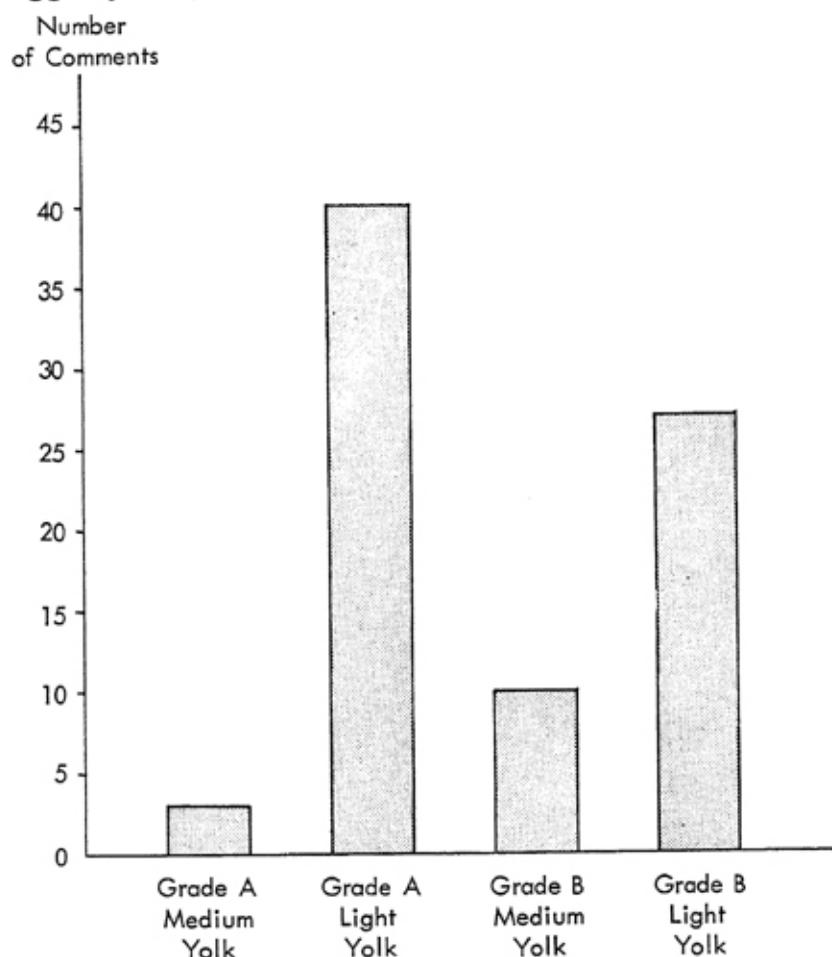


A second analysis consisted of examining the number of favorable and unfavorable comparisons between each class of egg received in the study and the eggs the household received from its regular source (Figure 2).

The results of the analysis of the ratio of favorable and unfavorable comments and comparison with eggs received from other sources both show that Grade A medium yolk color eggs were preferred over the other three. There were no significant differences among the other three classes. These results were identical with results of the analysis of variance of rating scores and of chi-square analysis of the differences in the frequency of nine scores.

The difference in the number of dislike comments made about the different kinds of eggs by respondents who rated the eggs less than nine, showed a consistent relation between preferences expressed by use of the rating score and the number of dislike comments about stand-up and yolk color by classes of eggs. These results provide additional evidence of the individual effects of yolk color and stand-up on the acceptance of the different classes (Figures 3 and 4

Fig. 4—Number of Dislike Comments on Yolk Color for Four Classes of Eggs by Cooperators Who Rated Them Less Than Nine.



compared with Figure 1). Significant differences in number of dislike comments about stand-up and yolk color are associated with actual differences in those properties of the eggs received (Figures 3 and 4).

Comments About Stand-Up and Yolk Color Were Used to Refine the Analysis of Rating Scores.

Comments about stand-up and yolk color that were made on the weekly score cards were used to separate the households into groups. The rating scores were examined to see what relationships existed between the comments of each group and the rating scores. Three methods of grouping on the basis of comments produced different results in analysis of variance of the rating scores. These differences indicate that the comments are useful in isolating some of the variance in the rating scores. It also permits generalizations about the nature of the frequency and distribution of different attitudes toward these attributes.

The first grouping was made on the basis of the attributes referred to by the cooperators. The comments were first divided into three mutually exclusive groups on the basis of whether they were related to yolk color, stand-up, or both of these factors. The number of households in each group was as follows:

Group I	Yolk color only	30
Group II	Stand-up only	61
Group III	Stand-up and yolk color	91

Analysis of variance of the rating scores showed no significant variation associated with the grouping itself, but did show significant interaction between the grouping and the grade. Examination of the mean scores of each group revealed that this interaction resulted from the fact that the group who commented only on yolk color did not differentiate between the different grades.

Method II consisted of grouping the households by *like* and *dislike* comments on stand-up. The relationships between these comments and the rating scores were examined by dividing all the comments on stand-up into three mutually exclusive groups. The 139 respondents who commented on stand-up were divided as follows:

Made only <i>like</i> comments	75
Made both <i>like</i> and <i>dislike</i> comments	33
Made only <i>dislike</i> comments	31

Analysis of variance of the rating scores on the basis of groups, grades, and color gave an F value large enough to be significant for groups and also a significant F value for the interaction between group and grade. These results limited the conclusions that could be drawn about the significance of the difference between groups. The presence of interaction indicated that the groups differed with respect to their ability or inclination to differentiate between grades by use of the rating scores. Examination of the mean scores of the individual groups revealed that the group who made no dislike comments on stand-up did not differentiate between the grades. Group II differentiated by both grade and color and Group III differentiated by grade but not by color.

Method III groupings were made on the basis of the *like* and *dislike* comments on yolk color. The 117 respondents who commented on color were grouped as follows:

Made <i>like</i> comments only	42
Made both <i>like</i> and <i>dislike</i> comments	29
Made <i>dislike</i> comments only	46

Analysis of variance of the rating scores of these groups for the four different classes of eggs gave a significant F value associated with group, grade, and color. The F values of the interactions were not large enough to be significant at the 5 percent level. This fact indicated that each group differentiated between the different classes of eggs by the rating scores. It also indicated that the mean scores of some groups were higher than those of other groups. Examination of the means revealed that the respondents who made no *dislike* comments had higher scores than those who had both *like* and *dislike* comments. Those who made only *dislike* comments about yolk color had lower scores than those who made both *like* and *dislike* comments.

The rating scores of the groups established by the three methods explained above were examined by chi-square analysis of number of nine scores in the different groups. In general, the results were consistent with those obtained through analysis of variance of the differences between the mean scores.

Analysis of Rating Scores Shows That Households Who Preferred Dark Colored Yolks Had Lower Scores.

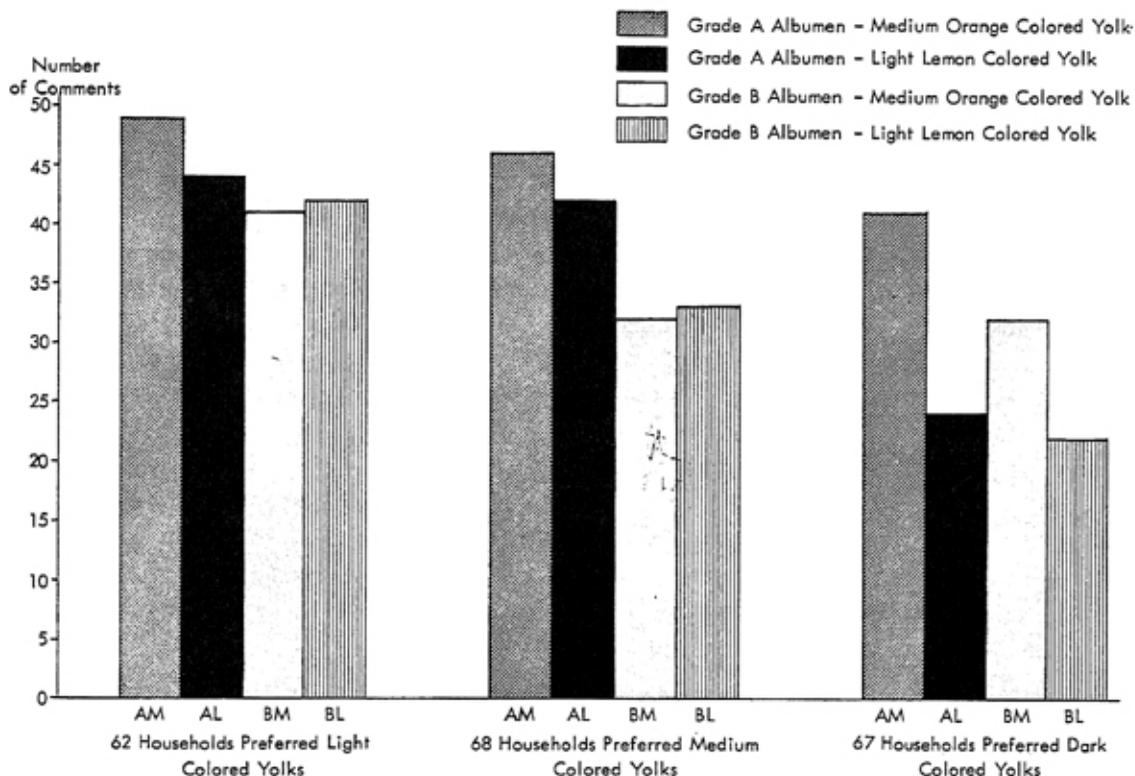
The color preferences expressed by 197 respondents in the terminating interview were used to separate the households into three groups:

Group I	Sixty-two households who preferred light yolks.
Group II	Sixty-eight households who preferred medium yolks.
Group III	Sixty-seven households who preferred dark yolks.

Analysis of variance of the rating scores on the basis of group, grade, and color gives significant values of F for each classification. The F value of the interaction is also significant at the 5 percent level, but the F value for the group effect is more than six times the F value of the interaction, thus indicating that the group effect is significant in itself. An examination of data from the different groups revealed that the mean scores for the group who preferred dark yolks were lower than scores for those who preferred medium yolks and the mean scores of the group that preferred light yolks were higher than the means for either of the other groups. Group I (the households that preferred light colored yolks) did not differentiate between the yolk colors by their use of the rating scores. Group II differentiated between the yolk colors by their mean scores and Group III differentiated more than Group II. It also appeared from the examination of mean scores that Groups II and III differentiated between grades more than Group I.

The number of satisfied and dissatisfied households for each of the four classes of eggs shows that those who preferred dark yolks (Group III) rated a larger

Fig. 5—Number of Respondents Who Rated Classes of Eggs Nine; Households Grouped According to Color Preference for Colored Disks.



portion of the medium yolk eggs nine than they did the eggs with the lighter yolk color (Figure 5). Chi-square analysis of the ratios shows that differences in the number of nine scores for the different yolk colors were significant beyond the 5 percent level.

Analysis of Rating Scores for Relationships with Socio-Economic Factors Gave Negative Results.

The mean rating scores were examined by grouping the households on the basis of the following socio-economic factors:

1. Income of household,
2. Number of persons in household,
3. Type of employment of head of household,
4. Housekeeper employed outside household,
5. Age of housekeeper.

There were isolated instances of difference between means of some of these groups, but these differences followed no orderly pattern in the sense that the means did not increase or decrease in a consistent relation to changes in the socio-economic factors studied. Only one factor, income, showed a consistent pattern in the sense that the mean scores increased as income increased. How-

ever, this increase was not large enough to be statistically significant when tested by analysis of variance.

The households were grouped on the basis of the following use and purchase characteristics:

1. The number of eggs used per week.
2. The source of most of eggs purchased.
3. The length of time eggs had been purchased from the same source.

The differences between the means of rating scores of these groups for the same class of eggs were small and did not show a consistent relationship with changes in the characteristics used to make the groupings. These features were also checked against the comment groups and the color preference groups, but no pattern of relationship was revealed.

No importance is attached to this section of the study except to report negative results from an attempt to show meaningful relations between socio-economic factors and egg preference. The data indicated that the preference and tolerance differences were randomly distributed with respect to the socio-economic groups and the use and purchase-source groups examined in the analysis.

Packages of Eggs with Mixed Yolk Colors and Mixed Grades Had Mean Scores Between the Scores for Each Grade and Color.

One package of eggs with mixed yolk colors and one with mixed grades were delivered to the households after the four different classes had been used and evaluated individually. In the fifth week of the study each household received one dozen Grade A eggs that contained six eggs with medium orange yolks and six with light lemon yellow yolks. In the sixth week each household received a dozen in which all the yolks were medium orange in color, but each carton consisted of six eggs from the Grade A group and six eggs from the Grade B group. It is recognized that many of the individual eggs from the Grade B group were not below the minimum quality standard for Grade A, but it seems appropriate to emphasize at this point that the cartons referred to as "mixed grades" included both the high and low limits of variation in albumen height for both Grade A and Grade B described in the quality control section of the study.

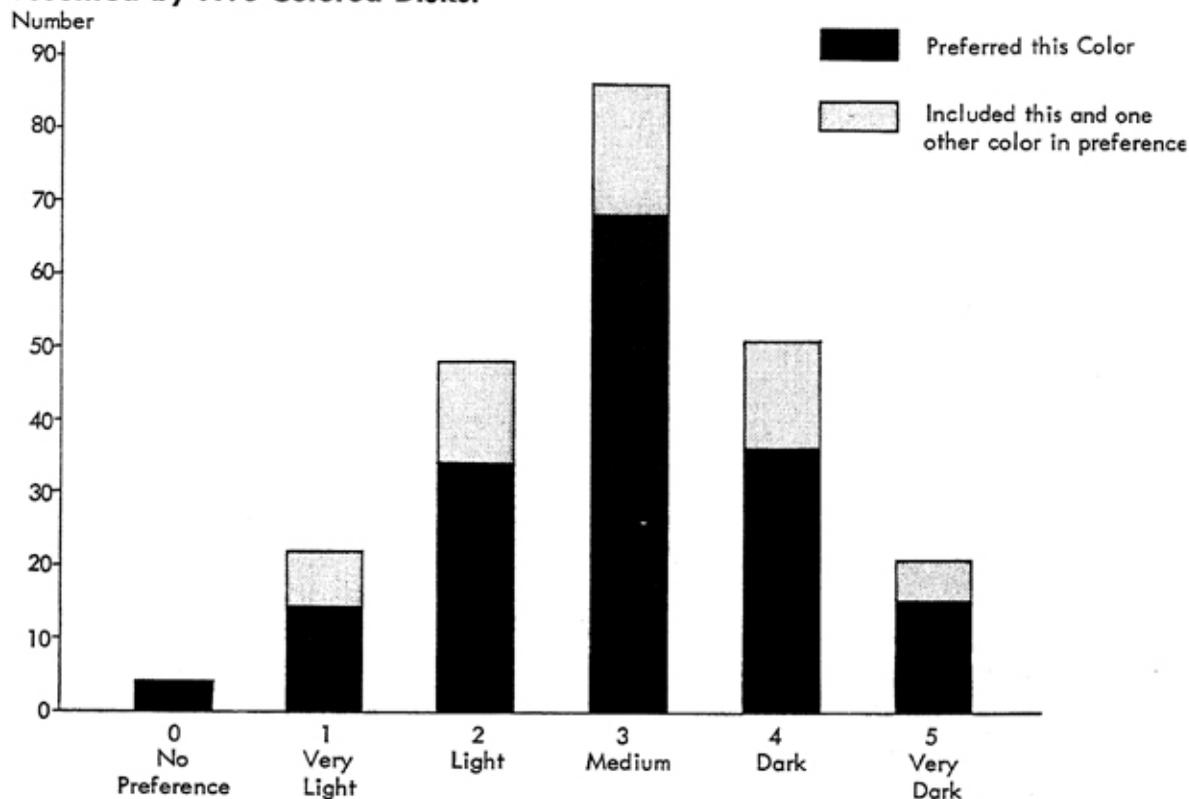
The mean rating scores for the cartons of eggs with mixed yolk colors were compared with mean rating scores of the packages of Grade A eggs with medium orange yolks and the Grade A eggs with light lemon yolks. The mean score of the packages with mixed yolk colors was 8.2 compared to 8.4 for the medium yolks and 8.1 for the light yolks. The mean score of the packages with mixed grades was 8.3 compared with scores of 8.4 for Grade A and 8.1 for Grade B. In both instances the scores for mixed cartons were between the scores for un-mixed cartons. When the differences between these mean scores were tested by analysis of variance, the difference between the grades and the difference between the colors were significant at the 5 percent level, but the means of the mixed cartons were not significantly different from either of the others. The results did

not support the opinion frequently expressed in the egg industry that uniformity of color is more important to the consumer than the color itself. However, they did support the evidence presented in previous analyses that many consumers have considerable tolerance for variation in albumen thickness.

Medium Yolks Were Preferred by More Households Than Light or Dark Colors.

The preceding analysis of rating scores indicates that the respondents as a whole preferred medium orange colored yolks over those with the lighter lemon color. The influence of variation in yolk color on the mean rating scores, the frequency of nine and less than nine ratings, and the frequency of like and dislike comments on yolk color have been shown. An examination of the individual rating scores and the comments made on yolk color by the different respondents reveals that some of the households preferred the lighter yolks. This was anticipated from other studies and a supplementary effort was made to determine the yolk color preference of each household in the terminating interview. Yolk color preference was indicated by choice and rejection of colored disks used to represent different colors of egg yolks. A set of five colored disks mounted on a white background was used to secure additional information about preferences for yolk colors over a wider range than the two colors presented in the eggs used and evaluated (Figure 6). These disks were presented

Fig. 6—Number of Respondents Preferring Different Yolk Colors as Represented by Five Colored Disks.



to each respondent near the end of the terminating interview. The respondent was asked to indicate which of the five disks most nearly represented the color of egg yolk preferred. One hundred ninety-seven respondents chose one or more of the disks as representing their color preference. The remaining four indicated that they had no color preference in egg yolks. Sixty-eight of the cooperators chose disk 3, a medium orange color; 37 chose disk 4, which was a darker orange; 34 chose disk 2, a lighter colored disk; 15 chose the darkest colored disk; and 14 chose the lightest colored disk. Twenty-nine respondents indicated some combination of two disks. Twelve of these selected 3-4; eight 1-2; six, 2-3; and three selected 4-5.

On the basis of these data, two groupings of the households were made for purposes of making more generalized statements about the yolk color preferences of the cooperators. The first grouping was made by starting with the 68 households that chose disk 3 and none of the others. All of the others were divided into two groups, one that preferred a lighter color and another that preferred a darker color. On the basis of this classification:

- 68 respondents preferred disk 3 (medium orange),
- 67 respondents preferred darker than disk 3, and
- 62 respondents preferred lighter than disk 3.

This classification placed 12 households in the darker preference group that included disk 3 and 6 households in the lighter preference group that included disk 3. Another method of grouping gave the following results:

- 86 respondents included disk 3,
- 55 respondents preferred darker than disk 3, and
- 56 respondents preferred lighter than disk 3.

Disk 3 was slightly darker in color than the medium colored yolks used in the study. Thus, the results of the data from the selection of the colored disks indicate that only 56 respondents preferred a color lighter than the medium colored yolks received in the study; 141 respondents (86 plus 55) preferred a color as dark or darker than the darkest yolk color they actually received and one-third of the respondents (67 of 201) preferred a color darker than any received in the study.

Two characteristics stand out in the results on color preferences. They are the higher frequency of preference for disk 3 color over the others and the symmetrical distribution of preferences on both sides of this central tendency. Two statements about the distribution emphasize these findings.

1. Disk 3 was included in the preference of 45 percent of the respondents or they expressed no preference (90 of 201 households). The preferences of the other 55 percent were about equally divided between lighter and darker colors.
2. The medium yolk color used in the study was quite close to the yolk color preferred by one-third to one-half of the respondents and the remaining one-half to two-thirds of the sample were rather evenly divided

between those who preferred darker yolks and those who preferred lighter yolks.

These results show that there was considerable variation in yolk preference. The findings are consistent with the results of other studies (Table 6).

In addition to the question on preference for the colors represented by the different disks, the respondents were asked if any of the five colors would make an egg unacceptable to them. Only 51 cooperators (one-fourth) said that none of the colors would make an egg unacceptable to them (Figure 7). Many respondents rejected more than one color. The very dark and the very light colors were rejected more frequently than the others. Disk 5 was rejected by 55 percent of the respondents and disk 1 by 46 percent. They showed more tolerance for the colors represented by disks 2, 3 and 4. Disk 3 was rejected by only one respondent, disk 4 by eight, and disk 2 by 18 (Figure 9).

Approximately Half of the Respondents Indicated That Yolk Color Was Important.

The 197 respondents who indicated a color preference by selecting one of the five disks were asked if it was important to them to get the color of egg yolk they preferred. Ninety-eight of 197 said that it was important. Of these 98, 38 preferred a medium orange color, disk 3; 30 preferred a color darker than disk 3; and 30 preferred a lighter yolk than disk 3.

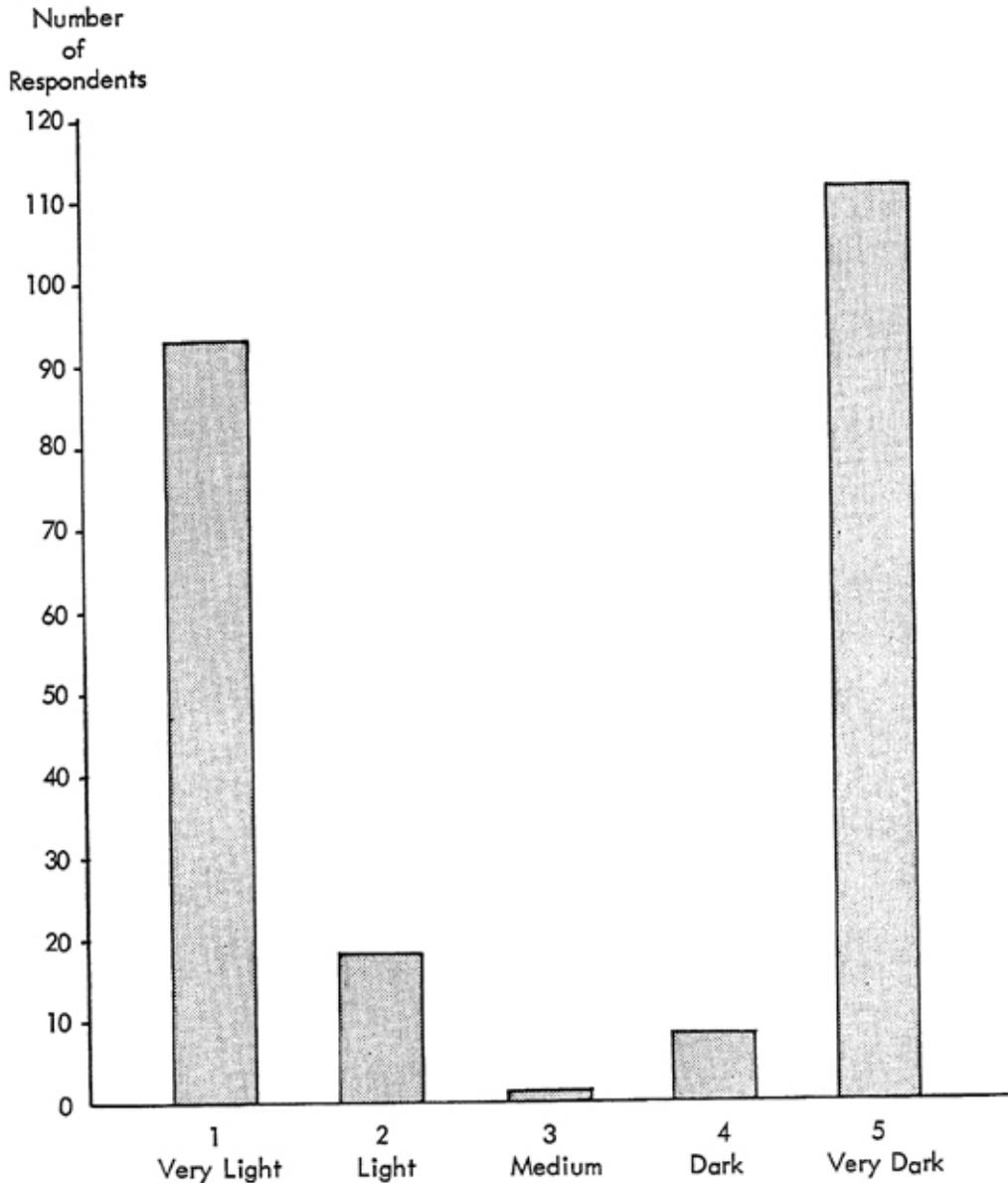
It is difficult to make inferences about market behavior from the preference and tolerance data cited above. However, it should be noted that in the acceptance of the eggs as indicated by the rating scores, the effect of variations in color was approximately equal to the effect of variation in albumen height. This effect of yolk color on the evaluation of eggs is assumed to have been moderated by the fact that some of the respondents preferred the lighter yolk colors, and still the mean scores of the entire group indicated that the medium yolks were preferred over the lighter yolks by approximately the same amount as the Grade A was preferred over the Grade B.

Comments Were an Indication of How the Households Evaluated the Eggs.

The weekly schedules provided an opportunity for the cooperators to comment on the eggs they received. Separate spaces were provided for the respondents to comment on anything they especially liked and anything that they did not like. This attempt to divide the comments into favorable and unfavorable was the only effort to guide or direct the responses. All of the comments were grouped, assigned a code number and recorded on punch cards. The frequency of different code categories was tabulated. Those that occurred less than 10 times (5 percent of the sample) in each week of the four-week period were grouped as other comments and were shown in this category only.

The 201 cooperators made 1,304 comments about the eggs during the four-week period (Table 2). There were almost twice as many favorable as unfavor-

Fig. 7—Number of Respondents that Rejected Each of Five Colored Disks Used to Represent Five Yolk Colors of Eggs, St. Louis Egg Preference Study, 1959.^a



a. Many households rejected more than one color. Fifty-one of 201 households did not reject any of the five colors.

TABLE 2-NUMBER OF COMMENTS ON EGGS BY WEEKS, ST. LOUIS
EGG PREFERENCE STUDY, 1959

Attributes	Total Comments	Week 1		Week 2		Week 3		Week 4		Total	
		Like	Dislike	Like	Dislike	Like	Dislike	Like	Dislike	Like	Dislike
Stand-up	340	83	14	47	18	55	43	43	37	228	112
Yolk color	220	32	9	23	48	31	19	23	35	109	111
Taste	246	55	10	45	20	33	21	39	23	172	74
Good or fresh	178	51	1	51	0	37	0	36	2	175	3
Texture and cooking	77	20	8	16	4	7	8	8	6	51	26
Blood spots	33	---	12	---	11	---	4	---	6	---	33
All other comments	210	38	24	21	22	21	33	26	25	106	104
Total comments	1,304	279	78	203	123	184	128	175	134	841	463

TABLE 3-RESPONSES IN FINAL INTERVIEW TO VARIATION IN EGGS BY 201 HOUSEHOLDS AFTER USING
SIX DIFFERENT CLASSES, ST. LOUIS EGG PREFERENCE STUDY, 1959^a

Responses	Yes	No	Total	Attribute that Varied				
				Stand-Up		Yolk Color	Taste	Blood Spot
				Albumen	Yolk			
Noticed variation between cartons.	173	28	201	63	35	125	40	5
Variation between cartons was important.	94	107	201	30	18	44	24	7
Noticed variation within cartons.	92	109	201	30	17	36	6	13
Variation within cartons was important.	45	156	201	14	5	10	4	12

^aEach household received one dozen eggs each week for six weeks in the following order: Grade A, medium yolk color; Grade A, light yolk color; Grade B, medium yolk color; Grade B, light yolk color; Grade A, mixed medium and light yolk color; and Grades A and B mixed, medium yolk color.

able comments (841 versus 463). Eighty-four percent (1,094) were included in the six most frequent categories shown in Table 2. The six categories were: stand-up, taste or flavor, yolk color, good or fresh, texture and cooking properties, and blood spots. They were the only comments made by 5 percent or more of the respondents in any week of the four-week period. Seventy-four percent (806 of the 1,094 comments) were about three categories:

Stand-up	340 comments,
Taste	246 comments,
Yolk color	220 comments.

Favorable comments on stand-up occurred twice as frequently as unfavorable comments (228 versus 112). Favorable comments on taste occurred more than twice as often as unfavorable comments (174 versus 74). There were approximately the same number of favorable and unfavorable comments on yolk color (109 favorable and 111 unfavorable).

The experimental design of the study focuses attention on comments about stand-up and yolk color. The subjective nature of taste and flavor, good and fresh, and texture, limits the use of these comments for analytical purposes. Observation of the original comments indicated that many of the households assumed some relationship between stand-up and/or yolk color and one or more of the three subjective comment categories.

Dawson and others report a positive relationship between flavor scores and grade quality that is consistent with the tendency of the respondents in the present study to make more unfavorable comments about the taste of the Grade B eggs received in weeks 3 and 4.⁹

Respondents were asked if the eggs received in the study had more or less variation than those they usually used. Seventy-five of the respondents thought the eggs received in the study had more variation than those usually used. Fifty-eight respondents said there was about the same amount of variation and 68 said that the eggs from the study had less variation than those they usually used (Table 4). The respondents were also asked what qualities varied more or less than the eggs usually used. Of the 75 that said the study eggs varied more, 28 listed albumen stand-up, 15 said yolk stand-up varied more, 51 said yolk color varied more, and 14 said taste varied more than the eggs they usually used. Of the 68 who said that the University eggs varied less, 20 said there was less variation in albumen stand-up, 10 said there was less variation in yolk stand-up, 34 said there was less variation in yolk color, 7 said there was less variation in taste, and 8 said that there were fewer blood spots than in the eggs usually used.

Unacceptable cartons were reported by 29 respondents (Table 25). Eleven respondents said that taste made the eggs unacceptable. Seven referred to blood spots, 4 to albumen stand-up, one to yolk stand-up, and 3 to yolk color. Thirty-eight respondents reported individual eggs that were unacceptable. Twenty-four

⁹Elsie H. Dawson, Cora Miller and Ruth A. Redstrom, *Cooking Quality and Flavor of Eggs*, Human Nutrition Research Branch, Agricultural Research Service, United States Department of Agriculture, Agricultural Information Bulletin No. 164 (Washington: Government Printing Office, December, 1956), pp. 14-15.

TABLE 4-COMPARISON OF EGGS RECEIVED IN THE EXPERIMENT WITH EGGS USUALLY USED,
ST. LOUIS EGG PREFERENCE STUDY, 1959

Comparison	Number of Households	Attributes that Varied					Blood Spots
		Stand-Up		Yolk Color	Taste		
		Albumen	Yolk				
Eggs received from the University had more variation than the eggs usually used.	75	28	15	51	14	0	
Eggs received from the University had less variation than the eggs usually used.	68	20	10	34	7	8	
Eggs received from the University had the same amount of variation as those usually used.	58	--	--	--	--	--	

TABLE 5-RESPONSES IN FINAL INTERVIEW TO UNACCEPTABLE EGGS RECEIVED IN THE EXPERIMENT,
ST. LOUIS EGG PREFERENCE STUDY, 1959

Responses	Acceptable			Unacceptable				Blood Spot
	Yes	No	Total	Stand-Up		Yolk Color	Taste	
				Albumen	Yolk			
Received cartons of eggs that were unacceptable.	29	172	201	4	1	3	11	7
Received cartons that contained individual eggs that were unacceptable.	38	163	201	3	4	0	3	24

of these referred to blood spots, 3 to taste, 4 to yolk stand-up, and 3 to albumen stand-up.

The eggs that were used were flash candled by the University of Missouri poultry department, and those that were defective were removed. However, there were 33 unfavorable comments about blood spots during the four-week period. Only one of these households commented on blood spots in two different weeks. One additional cooperator commented favorably that no blood spots were found though they often occurred in eggs bought from the farm. The mean scores of the respondents who commented on blood spots was six-tenths of a point lower for the packages of eggs that were reported to have had blood spots than for those received during the entire four-week period (7.6 for weeks when comments occurred and 8.2 for the entire period).

Final Interview Supported the Responses in Weekly Schedules.

In the first section of the terminating interview, the cooperators were asked a series of questions about whether or not they noticed variation in the eggs they received in the study. Those who gave affirmative answers were asked how the eggs varied and if the variations influenced their degree of acceptance. Variation was noticed between the different cartons by 173 of the 201 respondents (Table 3). Variation in yolk color was noticed by 125. Variation in albumen stand-up was mentioned by 63 respondents and in yolk stand-up by 35 for a total of 98 comments on stand-up. Taste was mentioned by 24 and blood spots by seven. Only 92 cooperators indicated that they noticed variation between the eggs within individual cartons. These respondents mentioned the same four characteristics. Albumen stand-up was mentioned by 30, yolk stand-up by 17, yolk color by 36, taste by 6, and blood spots by 13. The only type of variation mentioned in discussing individual cartons more frequently than in discussing variation between cartons was blood spots. Variation between cartons was important to 94 respondents, approximately one-half of the sample. Variation within individual cartons was important to 45 respondents, less than one-fourth of the sample.

The relationship between yolk color and flavor is not known, but the cooperators made more unfavorable comments about the taste of eggs with the lighter colored yolks. A tendency also was noted for both those who preferred the lighter yolk colors and those who preferred the darker colors to associate intensity of flavor with intensity of color. Those who preferred light yolks tended to refer to them as having a mild, delicate flavor. Those who objected to the light yolks referred to them as tasteless. Respondents who objected to the darker yolks referred to them as strong. Favorable comments about dark yolks included references to nice, rich flavor. It is interesting that comments on taste occurred more than any other class except stand-up.

The 340 comments on stand-up included 178 about albumen and 162 about the yolk. Seventy-eight percent of the comments about yolk stand-up were favorable, while only 57 percent of those about albumen were favorable. The high

frequency of comments about yolk stand-up are consistent with Bender's and Stadelman's findings on the importance of the yolk in consumers' evaluation of eggs.

The large group of miscellaneous remarks referred to as *other comments* contained references to chalaza, spots, fertile eggs, sperms, etc. It was obvious that some respondents associated the chalaza with fertility, but other comments about fertility and spots were general and could not be definitely associated with the chalaza. If all of them could have been grouped together, the number would have been above the arbitrary 5 percent and would have constituted a seventh category.

The failure to contribute any conclusive information about the importance of the chalaza in judging the quality of an egg may have been due to the methodology employed in the study. The "maximum awareness" principle employed by Bender and Stadelman in taking the interview in the presence of the broken-out egg was absent.¹⁰ Also, there was no interviewer present to assist the respondent to identify the chalaza.

IMPLICATIONS OF RELATED THEORY

Different Preference Patterns Imply Different Interactions Between Product Grading and Demand.

The present structure of the egg industry permits and encourages monopolistic competition among large producers, handlers, and retailers.¹¹ The demand for eggs is directly influenced by the availability, the price, and the attractiveness of other products. Eggs and alternative food products that consumers consider substitutes for eggs are referred to as clusters of substitutes.¹² Different classes or grades of eggs and the alternative food products that compete with them for the consumers budget are differentiated products.¹³ Potential purchasers recognize differences between them but consider them as possible substitutes for each other in filling specific wants.

Interactions between preferences and product differentiation influence the demand for each particular product among a cluster of substitutes. The nature of these interactions depends on the strength and distribution of the preferences among consumers. A system of classification of consumers' preferences used by research workers at this experiment station in studying consumers' preferences for beef steak is useful in evaluating the effect of product differentiation on the demand for products under conditions described by each of three designated pre-

¹⁰L. D. Bender, "Consumer Preferences for Interior Quality of Eggs," (unpublished Ph.D. dissertation, the University of Missouri, Columbia, 1959), p. 42.

¹¹Edward H. Chamberlin, *The Theory of Monopolistic Competition*, (Cambridge: Harvard University Press, 1950), p. 204.

¹²Ruby Turner Norris, *The Theory of Consumer's Demand* (New Haven: Yale University Press, Revised 1952), p. 149.

¹³Edward H. Chamberlin, *The Theory of Monopolistic Competition*. (Cambridge: Harvard University Press, 1950), p. 214.

ference classifications.¹⁴ Previous research reports define these classifications as follows:

- (1) Identical—consumers agree as to quality variations and as to relative prices they are willing to pay for these qualities.
- (2) Similar—consumers agree as to quality variations but they do not agree as to relative prices. For example, all consumers agree that this steak is better than that one; one group of consumers would pay as much as 50 cents a pound more to get the better one, while the other group would not pay more than 10 cents a pound to obtain it.
- (3) Opposing—consumers disagree as to relative qualities and prices. For example, one group of consumers thinks this steak is better than that one, while another group thinks the converse.

The recognition that different kinds or grades of a product can be considered as different products implies that the total demand for a specific product such as beef steak or eggs may consist of a summation of the individual demand schedules for two or more differentiated products. A given group of potential consumers may be distributed along these demand schedules in different orders. Many of the same group of consumers also appear on the demand schedules of products that are close substitutes for eggs, and it is the interaction between these different demand schedules and the supply condition that prevails in the market that results in sales.

The problems of summarizing the demand schedules for each of several differentiated products into one schedule for a product such as steak are different for the different classifications of preferences used by Rhodes.

Identical Preference Is the Simplest Type of Marketing Problem That a Given Industry Can Face.

If potential consumers have identical preferences the industry can maximize its sales by offering products that meet this preference as closely as possible. If meeting various levels of minimum standards has the same cost to all suppliers, all should strive for and achieve the same degree of perfection in their efforts to market the preferred product. The demand for each degree of perfection and the costs of achieving this level will determine the price of the product and the degree of perfection attained. All buyers will agree on the price they will pay for the product that meets this standard. If a less preferred product is produced in the effort to produce the preferred one or because different firms have different costs, it may be sorted out and sold at a lower price and all buyers will agree on the price reduction that is necessary to equate the satisfaction of the purchaser of the less preferred product with the purchase price. The more of this lower priced product that replaces the preferred one, the lower the total revenue of the industry. All consumers would have been willing to pay the higher price for the preferred product. Total revenue of the industry will be at a maximum when all

¹⁴V. James Rhodes, "Acceptance and Yield of Choice and Good Beef: Research Results and Implications", *Journal of Farm Economics*, Volume XLIII, Number 2, May, 1961, p. 192.

consumers buy the preferred product at the higher price.¹⁵ Members of the industry will be concerned about keeping the volume of the less preferred, lower priced product at a minimum and may find it advantageous to keep it off the market completely. If the level of technology is high and the processes of production are understood and can be adequately controlled without increasing costs, only one class of product will exist on a market where the buyers have identical preferences. However, if production processes are such that the product is heterogeneous and many inferior products are produced in the process of producing those that are more desired, these less desired units may be sold at lower prices. They exist and their sale may add more to net revenue than the production and sale of an additional volume of the more preferred class of the product.

In egg production the level of technology is high, the production possibilities are known and the cost of different degrees of standardization can be determined. If all consumers are agreed on the class of product they prefer and the prices they will pay for this and other classes, producing and marketing firms can know what these prices are. If standardization increases the cost, the industry problem reduces itself to finding the optimum combination of standardization and cost that will maximize industry interest.¹⁶ It is expected that a highly developed industry facing this sort of preference situation would produce a product that was rather close to this optimum and would tend to adjust toward it.

If preferences for eggs are identical, the demand for eggs versus egg substitutes is not likely to be affected directly by the number of classes of eggs offered to consumers. This conclusion is drawn from observations and assumptions about the nature of the supply functions of eggs. All consumers will be willing to pay the same prices for the same class of eggs. It is assumed that different producers' costs for the same classes of eggs are likely to be similar and that each producing and marketing organization will try to produce and sell the same class of eggs in order to maximize its net returns. Technology is available to all members of the industry so they would have a high degree of success in producing this class. Its characteristics would be determined by the cost of producing these characteristics and the price consumers would pay for the eggs that met these standards. Variation in the product would be due to variation in producers' costs or to imperfect production control. It is assumed that the differences in cost of production and the lack of control over production processes would not be sufficient to cause more than one class to persist in the market.

It is recognized that the closer the available class comes to being the ideal class, the more of it will be taken at a given set of prices of it and its substitutes. The desire to gain product acceptance by producing the highest possible quality, plus the assumption of identical preference would be a logical basis for industry

¹⁵If the income effect of the price of eggs is important, this statement is not necessarily true. It is assumed to be unimportant in its aggregate effect on sales at present prices and incomes.

¹⁶Both the substitution effect and the income effect of price changes of eggs are believed to have little effect on the quantity consumed within the expected range of prices for eggs and egg substitutes.

efforts toward higher quality-standards and for educational and promotional activities to raise them. The class available in the market can influence the total sales of the product. But in the case of identical preference, reducing the costs of producing a more preferred class is the only means of getting it on the market.

The assumption of identical preference may have been very realistic and very useful when quality grade standards were established in the 1920s. The major problem was one of sorting the given distribution of very heterogeneous eggs into classes that included a grade suitable for frying and into other grades that were suitable only for uses that permit lower product performance. Identical or universal preference for each use class may have been a useful and realistic assumption for solving the egg industry's major marketing problem. There was a wide range in the quality variation of eggs in the market at that time and it seems possible that consumers had an identical preference for fresh eggs and were in agreement about which eggs were fresh. The problem was to identify the fresh eggs in the shell in the market place. There was no assurance that the available supply of a particular grade would respond quickly to give consumers all they wanted of a particular grade at the long-run cost of producing that grade. Price fluctuated to ration the available supply equitably among consumers. Producers were small, production and marketing practices varied widely and the practical approach to quality grading was to consider it mainly a sorting problem rather than a procedure for establishing product specification to guide production decisions.

Price differentials between grades were empirically confirmed when graded eggs were sold. This difference was consistent with an assumption of identical preference. Poultry specialists were inclined to point out how much could be added to egg producers' incomes if all of the eggs sold were grade A and to advocate higher quality as a means of increasing demand. This emphasis seems to imply an assumption of identical preference. It was probably a useful assumption a few years ago.

Future production is expected to be characterized by large efficient units. The degree of control over production processes will be high. The major marketing problem will be for managers and production specialists to examine different sets of production procedures that can be used to produce different products and to determine which of these choices will give them the best competitive position with their rivals.

If the production functions for each class of eggs are similar for all producing and marketing organizations, and if consumers have identical preferences, only one class of eggs can exist in the market and this class will be dictated by the cost of production, consumers' preference, the price and availability of substitutes and consumers' income. If preferences are identical the products will be identical also and consumers cannot choose among classes of eggs but merely between eggs and egg substitutes.

If preferences are "similar" the demand schedules of different consumers for a particular class differ only with respect to their elasticity. The total demand for the products can be summarized, but the total demand is likely to be more elastic than the demand for a product with identical preferences. The existence of different shapes in the individual demand curves gives producing and marketing organization a wider range of market strategies.

In the case of identical preferences the individual demands of the many persons who make up the total demand are identical and there is only one possible set of prices for a given distribution of a given quantity of different grades of the same product in a given market. However, if preferences are similar the individuals differ with respect to how much they will pay for a given grade of the product when other grades are available at given prices. The total revenue from selling two grades or classes may be greater than the total revenue from selling either of the grades individually. If the total demand for two or more classes or grades of a product is larger than for one of these, the marketing organization may deliberately divide the market by selling differentiated products at different prices. If the preferred product has a higher cost of production and must be sold at a higher price to cover cost, only part of the potential consumers will choose this product at the higher price over the less preferred class or grade at some lower price.

If some purchasers are willing to pay more for the preferred product than other consumers are willing to pay and if the cost of producing the preferred product is higher than the cost of the other, then some basis for deliberate differentiation exists. The question of whether or not this differentiation "will pay" is an empirical question that must be answered for each set of production costs in each market situation. If preferences are similar, if production costs differ and if the preferred product has the higher cost, there is a theoretical basis for product differentiation and a multiple pricing policy. If costs can be reduced by differentiating the product and offering one or more cheaper grades, this multiple standard and multiple price policy may permit a broader range of quality and price competition with substitute products and thus serve the interest of the entire industry. If there is no difference in the average cost of total product or if the average cost is increased by producing more than one class, there is no logical economic reason for deliberately producing two or more classes of a product by setting different standards or specifications for different classes. Differentiation may occur in the sense of selling the same class of the product to different individuals at different prices but there is no basis for differentiating in the products on the basis of their own attributes unless the less perfect classes have a lower cost.

Unless there is a substantial difference in both cost of production and consumers' tolerance of variation from the preferred product, it seems unlikely that differentiation will be an important competitive tool for an industry that produces a product for which consumers express similar preferences.

However, if consumers express opposing preferences for a product, there is more reason to believe that the competitive position of the industry will be affected by the amount of differentiation, or the number of choices offered. Excessive standardization has the effect of eliminating one or more products from a cluster of substitutes. There is no obvious way to determine the portion of this unsatisfied demand that will be assimilated and served by the industry that supplied the eliminated product. Much of it may be transferred to other industries that offer substitute products. It is suggested that in areas of opposing preferences the amount of product differentiation is a very important element in the rivalry of production and marketing organizations for optimum volumes of sales.

The trend toward increased product differentiation in breakfast cereals and in cheese are cited as examples of products where increases in sales have accompanied increases in variety and availability.

The complexity of the problem may be observed in more detail by recognizing some of the different sources or causes of product differentiation.

Differentiation occurs in the production process from conscious deliberate choices on the part of the production manager and also from lack of knowledge or imperfect control over the production process. Production may be divided into process of physical product production and into various processing, transporting and marketing services, and in each of these arbitrary divisions there is further differentiation that arises from both deliberate decisions and imperfect control. As technology improves and production functions become better known by production managers, the differentiation that occurs from deliberate decisions becomes relatively more important. It also seems useful to distinguish between the decisions that are made in an effort to reduce the cost of production and permit the producer to increase his profits per unit or reduce price, and decision to change the product in an effort to make it more acceptable to consumers or handlers at the same or higher prices. The latter type of changes occur from knowledge or beliefs that the producer has about tastes and preferences of potential customers.

If one looks into the history of egg grading, its most obvious role has been one of sorting the eggs marketed by producers into more homogeneous lots, and thus, to segregate and identify products that were differentiated on the basis of certain attributes. Much of this differentiation occurred through imperfect control of the production and marketing process and sorting was very useful in facilitating trading among handlers and assisting consumers in choosing eggs that met certain minimum standards. If one looks at present conditions and tries to anticipate the future, the influence of grading programs on producers' and handlers' practice and on the design of attributes of the egg produced may be more important than the sorting after production is accomplished. If producers have a high degree of control over the production process and, therefore, are able to standardize the product, it is quite important that they also have a high degree of information about what attributes consumers use to evaluate the pro-

duct. They also need to know something about the relative weights consumers place on the various specifications of these attributes.

Number of Classes of Eggs May Influence Demand.

Different grades, sizes, or classes of eggs were regarded as differentiated products. Differentiation is important in the market place when the summation of individual demand curves for differentiated products have different positions or different shapes from the demand curve for the alternative homogeneous product. Products that have the same demand are perfect substitutes and therefore the same product in the market sense. Clusters of substitutes are groups of differentiated products that have interrelated demands. The quantity and the price level of each product in the complex has a determining influence on the quantity and price of other goods in its particular substitute cluster. This concept is in contrast with the more traditional concept or assumption that a price change in the principal commodity is absorbed by infinitesimal quantity changes on the part of its "many" substitutes.

The adoption of the concept of substitute clusters and the rejection of the concept of infinitesimal changes emphasizes the importance of product differentiation and the interaction of related demand schedules of small clusters of close substitutes. Eggs are assumed to be close substitutes for products that are characterized by a great deal of product differentiation. If a product like eggs is considered, a close substitute for other products such as a specific brand name breakfast cereal or a certain type of breakfast rolls, it is conceivable that the cereals or the breakfast rolls may be a closer substitute for a particular grade or class of eggs than some alternative grade or class of eggs. When tastes and preferences of consumers differ with respect to certain characteristics of a group of products that are close substitutes for each other, the producers of a given product in this cluster may win a larger share of the market for their product by offering more differentiation. The role of grade standards and grade labels in this rivalry depends to a considerable degree on the performance of the industries producing and marketing the substitutes. The optimum amount of differentiation for the egg industry is dependent to some extent on the amount of differentiation available in rival products. Differentiation includes differences in the products themselves and also differences in convenience, availability, and activities to increase the consumer's awareness of the individual product.

RELATED RESEARCH

Other Research Guided the Experiment and Influenced the Interpretation of Results.

Previous research has identified many attributes used in evaluating the product.^{17, 18} Attributes such as albumen consistency, albumen, and yolk height are

¹⁷L. D. Bender, L. A. Voss and O. J. Cotterill, "Do Consumer Grade Standards for Shell Eggs Reflect Consumers' Preferences for Interior Quality?", *Poultry Science*, Vol. 38, No. 4, July, 1959, pp. 882-887.

¹⁸W. J. Stadelman and others, "Egg Preferences of Spokane Consumers," *Poultry Science*, Vol. 36, No. 3, May, 1959, pp. 596-601.

biologically associated with each other to the extent that one tends to be an index or indicator of the other.¹⁹ Other attributes such as albumen height and yolk color can be varied independently of each other.²⁰

Albumen and Yolk Shape Were Evaluated Together as Stand-up.

Albumen consistency is very closely related to albumen height and these two are closely related to the size of the air cell.²¹ These three attributes are the major indexes of freshness and interior quality used in the two grading programs administered by the United States Department of Agriculture.²² Yolk height is also closely associated with the other three attributes but does not enter directly into grade determinations.²³ However, yolk height and/or yolk shape are important indexes of quality to many consumers and have been suggested as a possible grading criteria by research workers.^{24, 25} The close positive relationship between variation in any one of these attributes and each of the others suggests the possibility of grouping consumers' comments about albumen thickness, albumen height, and yolk height into a general classification that is referred to as stand-up.²⁶

Brant points out that:

Since the yolk index in newly laid eggs tends to vary less than albumen measurements, it is most useful for estimating the effects of aging. However, yolk index does not appear to be the determining factor in the appearance of opened eggs.²⁷

It seems reasonable at this point to ask if it may be a better index of aging than the Haugh units.

Stadelman and Bender have noticed in separate studies that many consumers use the condition of the yolk as an index in evaluating eggs and both suggest that the grading program include some consideration of the height or other condition of the yolk as one of the criteria for the establishment of grades.^{28, 29} Both Bender's and Stadelman's work raise the question of whether a single index of interior quality such as the Haugh unit is a satisfactory criterion for dif-

¹⁹A. W. Brant, A. W. Otte and K. H. Norris, "Recommended Standards for Scoring and Measuring Opened Egg Quality," *Food Technology*, Vol. V, No. 9, 1951, pp. 356-361.

²⁰Alexis L. Romanoff and Anastasia J. Romanoff, *The Avian Egg*, (New York: John Wiley & Sons, Inc., 1949), p. 126.

²¹W. E. Hauver, Jr., John A. Hamann and Lester Kilpatrick, *Egg Grading Manual*, Poultry Division, Agricultural Marketing Service, United States Department of Agriculture, Agriculture Handbook No. 75 (Washington: Government Printing Office, Revised, July, 1961), pp. 11-15.

²²Lester Kilpatrick, Albert W. Brant and Harlan L. Shrader, *Equipment and Methods for Measuring Egg Quality*, Poultry Division, Agricultural Marketing Service, United States Department of Agriculture, AMS No. 246 (Washington: Government Printing Office, Revised June, 1960), pp. 21-25.

²³Hauver and others, *loc. cit.*

²⁴Brant and others, *loc. cit.*

²⁵Stadelman and others, *op. cit.*, p. 598.

²⁶L. D. Bender, "Consumer Preferences for Interior Quality of Eggs," (unpublished Ph.D. dissertation, the University of Missouri, Columbia, 1959), p. 66.

²⁷Brant and others, *loc. cit.*

²⁸Stadelman and others, *op. cit.*, p. 601.

²⁹Bender (dissertation), *op. cit.*, p. 116.

ferentiating grades of eggs for consumers who use several factors in making their own evaluations. Bender points out that 60 percent of the consumers interviewed in St. Louis mentioned stand-up characteristics of the egg.³⁰ Stand-up is a more general term than either albumen thickness or yolk height.

Taste Related to Other Attributes.

Comments on taste and flavor have been noted in several consumer preference studies.³¹ The subjective nature of the attributes makes it difficult to evaluate these comments. A series of taste panel studies conducted by three experiment stations and summarized by Dawson, Miller, and Redstrom, reported a high positive relationship between candled quality of stored eggs and the flavor score.³² However, there was a wide range of flavor scores within the same candled quality as indicated by the following summary statement.

Intensity of off-flavor increased with an increase in storage time contributing to the lowering of flavor scores within a candled quality class. For example, eggs held in cold storage for 2, 4, and 6 months candled A quality consistently but averaged 93, 82, and 48 percent, respectively, in flavor scores expressed as percent of the value for newly laid eggs.³³

This suggests that grading by candling is not as reliable in protecting consumers from off-flavor in eggs that have been stored for considerable time as it is for eggs that have not been held in cold storage for more than two months before grading. The study also showed that oiling eggs resulted in a higher percentage of the stored eggs grading A and AA after given storage periods. However, there was a higher percentage of off-flavor eggs in the oiled eggs for each given candled quality class.

These results indicate that storage for several months, especially of oil treated eggs, could result in lower consumer acceptance in a given candled quality class than for fresh eggs of the same quality class.

Yolk Color Important to Some Consumers.

Bender notes that yolk color is important to many consumers and should be investigated further as a possible means of product differentiation. Jasper states that yolk color preferences "vary rather widely between different areas."³⁴

Averages calculated from a table in Jasper's summary show that 36.5 percent of the respondents preferred medium yolk colors, 19.5 percent preferred dark

³⁰*Ibid.*, p. 141.

³¹Jasper, *op. cit.*, p. 11.

³²Elsie H. Dawson, Cora Miller and Ruth A. Redstrom, *Cooking Quality and Flavor of Eggs*, Human Nutrition Research Branch, Agricultural Research Service, United States Department of Agriculture, Agricultural Information Bulletin No. 164 (Washington: Government Printing Office, December, 1956), pp. 14-15.

³³*Ibid.*, p. 14.

³⁴A. William Jasper, *Some Highlights from Consumer Egg Studies*, Poultry Branch, Production and Marketing Administration, United States Department of Agriculture, Agriculture Information Bulletin No. 110 (Washington: Government Printing Office, June, 1953), pp. 16-17.

TABLE 6-YOLK COLOR PREFERENCES EXPRESSED BY CONSUMERS IN SPECIFIED YEARS, BY CITIES OR STATES

City or State	Year Study Was Con- ducted	Yolk Color Preference			
		No Preference or not Stated	Light to Medium Yellow	Medium Yellow	Medium to Dark Yellow
New York City	1933	19.2	35.9	20.0	24.9
Providence	1928	21.0	21.5	21.5	36.0
Providence	1932	13.0	37.5	37.5	12.0
Baltimore	1938	26.3	28.8	--	41.4
Milwaukee	1945	33.4	33.3	--	33.3
Mansfield	1947	30.0	14.0	27.0	29.0
Minneapolis	1947	15.5	20.1	48.3	15.5
Columbus	1948-49	--	5.0	57.0	38.0
Wichita	1949	13.9	14.2	49.5	22.4
Upper Arlington	1949	30.8	25.8	27.5	15.9
Michigan	1949-50	28.6	26.4	39.5	5.5
Washington	1949	13.2	29.8	31.1	25.9
Des Moines	1949	33.1	12.5	29.6	24.8
Columbus	1950	14.0	12.7	38.7	23.6
Providence	1951	8.9	17.7	56.7	16.7
Providence	1952	11.3	37.1	31.3	20.3
Ithaca	1952	38.0	9.0	32.0	21.0
Average		21.5	22.5	36.5	19.5

SOURCE: Adapted from Table by A. William Jasper. Some Highlights from Consumer Egg Studies, Poultry Branch, Production and Marketing Administration, United States Department of Agriculture, Agriculture Information Bulletin No. 110 (Washington: Government Printing Office, June, 1953), p. 17.

yolk colors, 22.5 percent preferred light yolk colors and 21.5 percent had no preference.

A pioneer study of yolk color preference was done by Thomsen and Winton in 1933 in New York City.³⁵ The authors concluded that:

Trade discrimination against the darker shades of yolk color is only partly based on the erroneous belief that a majority of consumers prefer light yolks. Another reason for this discrimination is fear of prosecution for violation of official retail grades which are largely based on Federal standards and which contain references to yolk visibility.

Thomsen and Winton found that only 35.9 percent of the New York consumers preferred light colored yolks, but the trade discriminated against eggs with medium and dark yolks. This may indicate that commercial producers on the east coast were successfully using yolk color to differentiate their product from the eggs produced in the Midwest that tended to have darker yolks. It

³⁵F. L. Thomsen and Berley Winton, *Consumer Preferences for Egg Yolk Color and Shell Color in New York City*, Agricultural Experiment Station, University of Missouri, Bulletin No. 329 (Columbia: Agricultural Experiment Station, August, 1933), p. 23.

seems reasonable that eggs from large commercial flocks were more uniform than those from small flocks in the Midwest and that dealers associated light color with good quality. It also suggests that the opinions of traders and merchandisers may not reflect consumers' preferences accurately or completely.

Snyder summarized a Canadian study as follows:

A recent (1960) survey of consumer preference conducted jointly at the Royal Winter Fair by the Canada Department of Agriculture, the Poultry Products Institute, and the Department of Poultry Science, O.A.C. failed to show any definitely uniform yolk colour preference on the part of the consumers. Women tended to favour a lighter yolk colour than did men. Both city women and men favoured a lighter coloured yolk than did their country counterparts. Many of both groups were decidedly opinionated with little sound reason for such opinions.³⁶

Consumers Differ in Both Choice of Criteria and Evaluation of an Attribute.

A review of research reports distributed over a 27-year period of studies on consumer preferences for eggs indicates that consumers differ with respect to the attributes they use to evaluate eggs and that some consumers who evaluate the same attributes evaluate them differently. However, these studies do indicate some patterns in the distribution of preferences and some of these patterns appear to be persistent over the period of time and over the population areas covered in the studies. Some of the attributes that have received persistent attention in these reports are stand-up characteristics of albumen and yolk, yolk color, taste, freshness, odors, blood spots, and conspicuous chalaza. Some of these attributes are evaluated directly by egg grading programs, some are evaluated indirectly and others are largely ignored. The fact that consumers have different preferences for yolk colors appears to have had very little attention from the egg industry.

FINDINGS

Findings on Preference for Albumen Grade Standards.

Grade A eggs were preferred over the Grade B but Grade B eggs were completely satisfactory to more than one-half of the respondents. The respondents made more *dislike* comments about the Grade B eggs than about the Grade A and rated more of the Grade B less than "completely satisfactory." Also, poor stand-up was associated with a larger percent of the dislike comments about Grade B eggs than about Grade A eggs. The data indicate that between 53 percent and 81 percent of the respondents were completely satisfied with the stand-up of the Grade B eggs. The results showed that raising the grade from high B to high A reduced but did not eliminate dislike comments about the lack of

³⁶Earle S. Snyder, *The Production, Identification and Retention of Quality in Eggs*, Publication 446, Revised September, 1961, (Guelph: Ontario Agricultural College, 1961), p. 52.

stand-up in some of the Grade A eggs. Grade B eggs were specifically designated less than "completely satisfactory" because of poor stand-up by 19 percent of the respondents. Only 7 percent of the same respondents specified that the Grade A eggs were less than "completely satisfactory" because of poor stand-up.

Various methods of sorting the households into groups on the basis of socio-economic factors and by use and purchase practices produced eight groups from the 201 households. All of the groups produced in this manner preferred Grade A to Grade B eggs.

Respondents Who Made Only Like Comments about Stand-Up Did Not Differentiate Between Grade A and Grade B Eggs.

Classifying households on the basis of respondents' *like* and *dislike* comments about stand-up produced a group of 75 households who did not differentiate between the two grades of eggs. This group made *like* comments about stand-up in some eggs but made no *dislike* comments about stand-up of any of the four classes of eggs received in this study. An additional 72 households made no comments about stand-up. On the basis of the evidence provided by comment groupings, it appears that 73 percent of the respondents were completely satisfied with the stand-up characteristics of all eggs received.

Preferences for Stand-Up Characteristics of Eggs "Similar."

The consistent preference for Grade A over Grade B revealed by the different tools of analysis, the acceptance of the B eggs as "completely satisfactory" by over one-half of the respondents and the success in sorting the sample into groups who differentiated between the Grade A and Grade B eggs and groups who did not differentiate between them, indicated that the sample had "similar preferences" for stand-up as defined by Rhodes.³⁷ They preferred Grade A over Grade B but they differed in their ability or inclination to differentiate between the A and B eggs presented to them in this study. This difference appeared to be randomly distributed with respect to the socio-economic, use and purchase practice classifications used in this study. The only effective means found for isolating those who differentiated between grades from those that did not were the *like* and *dislike* comments made by the respondents about the eggs.

Two Grades of Stand-Up Could Permit a Wider Area of Price Competition and Quality Rivalry with Substitute Products.

If consumers have similar preference for Grade A and Grade B eggs as indicated by the St. Louis data, there may be an opportunity to market two grades. This opportunity exists if there is sufficient difference in the cost of producing and marketing the lower grade to permit a difference in the price between the preferred grade and the other. The research reported here provides no information about the existence of such a difference. This research indicates that when sufficient difference in prices does exist, similar preferences for stand-up suggest

³⁷V. James Rhodes, "Acceptance and Yield of Choice and Good Beef: Research Results and Implications," *Journal of Farm Economics*, Volume XLIII, Number 2, May, 1961, p. 192.

the possibility of selling more than one grade of eggs in the retail market. The possibility of two grades based on differences in stand-up may have rather limited interest for present production and marketing organizations. They appear to be quite willing to supply the market with an abundance of high quality eggs at prices that make eggs a good buy, compared to the same amount of nutrition and convenience in rival products.

However, this study shows that eggs with stand-up characteristics below present minimum Grade A standards met the requirements of 60 to 80 percent of the respondents. This compares to Bender's findings that 53 percent of the St. Louis sample in that study did not distinguish between Grade A and Grade B eggs on the basis of rating scores.³⁸ There would be no reason for egg marketing organizations to keep the stand-up characteristics of eggs above the present minimum standards for these customers. It is suggested that the albumen stand-up requirements could be lowered and the product would still be completely satisfactory to over one-half of the egg users. An average of 55 or even 50 Haugh units might be a more useful minimum standard than the present minimum of 60. Bender's suggestion that a yolk height index be substituted for the present albumen height index for one grade or class of eggs might be a practical means of accomplishing this lower minimum for albumen stand-up.³⁹

The data also indicate that a substantial group of respondents, 20 percent or more, were less satisfied with the eggs in the 60 Haugh unit stand-up class than they were with those that averaged 80 Haugh units. In fact, a few respondents indicated that they were not satisfied with the stand-up of all of the eggs from the class that averaged 80 Haugh units. This suggests that there is a demand from a very substantial minority of egg users for a grade or class of eggs that has stand-up performance as high or higher than the present minimum standards for Grade AA or the Fancy Fresh grade.

It also follows from these observations that if eggs that meet the higher standards are not available to consumers, eggs will be in a weaker position relative to rival products. If there is little or no difference in the cost of producing and marketing the higher grade, there will be little or no advantage to the egg industry in marketing the lower grade. If there is a difference in cost between the two grades and if some consumers are willing to pay the extra cost of the higher grade, the egg industry can compete more effectively with rival products by offering multiple quality grades at different prices.

All of these conditions are met by present supply and demand relationship. Different grades do exist and do sell at different prices. However, trends in production and marketing practices indicate that it is reasonable to expect more standardization from the supply side of the market as technology becomes more uniform. It does not seem probable that more than two quality grades will exist

³⁸L. D. Bender, "Consumer Preferences for Interior Quality of Eggs," (unpublished Ph.D. dissertation, the University of Missouri, Columbia, 1959), p. 143.

³⁹*Ibid.*, p. 152.

in the production and marketing environment ten years from now. It would seem expedient to continue the present Grade A Label with slightly lower minimum standards for stand-up, and to continue the Grade AA or Fancy Fresh grade with minimum standards for stand-up as high or higher than the present standards for those grades. It is also suggested that consideration be given to setting the minimum standards for stand-up of the new Grade A on the basis of the stand-up characteristics of the yolk. The Grade AA or Fancy Fresh grade should continue to emphasize albumen stand-up.

Regular grades and premium grades of the same product are offered to consumers by many private production and marketing organizations. Deluxe and super-deluxe, main-line and custom-line are terms that have been used to differentiate between classes of a product with different minimum specifications without implying inferiority. Standard and premium are believed to convey a different meaning from standard and sub-standard. It is also believed that Grade A and Grade B convey the same meaning as standard and sub-standard and that a Grade B label makes eggs unacceptable to some consumers who would find the same eggs acceptable if they were labeled Grade A. The evidence presented here and the reasoning from it are similar to evidence and arguments presented by Rhodes in studies of preferences for different grades of beef.⁴⁰ The problem of setting grade boundaries and selecting grade designations for a specific grade are essentially the same. The questions raised here about the inferior product connotation of the Grade B designation could be avoided by using grade names as has been done by the Fancy Fresh grading program.

The question of name versus letter grades may be compromised by having the letter grades start at the top and go up: A, AA, AAA, etc. The inherent difficulties of shifting from one system to the other seem to favor continuation of the letter grade designations. It is believed that lowering the albumen stand-up requirements of the present Grade A label to include the top one-fourth of the present Grade B range would eliminate the need for Grade B. It is believed that it would not be necessary to remove Grade B eggs from the market by legislation and regulation but such legislation would not be harmful to either the industry or the consumer. Grade B is believed to be disappearing from the market under present conditions.

Findings on Preference for Yolk Color.

Eggs with medium orange colored yolks were preferred over eggs with light lemon colored yolks. The preference for medium orange colored yolks over the light lemon colored yolks was evident in all of the methods used to show the preference for Grade A over Grade B. These methods included analysis of variance of the difference between the means of the different classes, chi-square comparisons of the number of "completely satisfactory" ratings for eggs with different colored yolks and analysis of number and kinds of comments about the different classes of eggs. All of these methods showed that the medium colored egg

⁴⁰Rhodes, *op. cit.*, p. 192.

yolks were preferred over the light ones, though the comments revealed that some respondents preferred the lighter colored yolks. The comments also indicated that other households considered the medium orange colored yolks too light and that they would have preferred a darker color.

Supplementary data were obtained by showing each household a set of colored disks and asking them to designate which of the disks most nearly represented the color of egg yolk they would prefer. The responses indicated that approximately one-third of the households preferred a color close to what they received in the medium orange colored yolks. Approximately one-third preferred darker colored yolks than the orange yolks received in the study. Slightly less than one-third preferred a yolk color lighter than the medium orange colored yolks they received. Four respondents expressed no color preference. These results were consistent with the preference expressed by the rating scores. They also were quite similar to results obtained by Thomsen and others in New York in 1933 and were generally consistent with results of several later studies in Midwestern cities.

Preferences for yolk color caused about the same amount of difference in the mean scores as preference for Grade A over Grade B. Comparisons of the rating scores, the number of "completely satisfactory" ratings, and comparisons of the number of *like* and *dislike* comments about the different classes of eggs indicated approximately equal strength of preference for grade and preference for color.

Respondents Expressed "Opposing Preferences" for Egg Yolk Colors.

There was a difference between the preference expressed for Grade A over Grade B and the preference expressed for medium orange yolks over lemon yellow yolks. Comments about yolk color indicated that some households preferred the lighter color. There was no indication that some households preferred B eggs over A. When households were grouped by like and dislike comments on stand-up and again on the basis of like and dislike comments on yolk color, both groups showed a very significant amount of variation associated with the attribute used for grouping. However, a significant amount of variation was associated with the interaction of group and grade when comments on stand-up were the criteria for grouping. Examination of the means showed that the group of respondents who made no *dislike* comments on stand-up did not differentiate between grades. Grouping on the basis of *like* and *dislike* comments on color showed no interaction between group and color.

Comments of the households about the yolk color of the different classes of eggs received, the results of analysis of rating scores and comments, and responses to questions about a series of different colored disks supported the conclusion that the sample expressed "opposing preferences" for yolk color. This contrasts with the conclusion that they expressed similar preferences for stand-up or grade. These differences have important implication for grading and labeling eggs with regard to grade and yolk color.

This study indicated that the two yolk colors presented to the respondents did not cover their range of preferences. One-third of the respondents preferred a color darker than any received. It is suggested that strong preference for the medium yolk color over the lighter one resulted from the fact that those who preferred dark colored yolks over medium colored yolks also preferred the medium yolk over the light one. The fact that the group who expressed a preference for dark yolks had lower mean rating scores for all of the eggs received supported the suggestion that their preference for darker yolk color influenced their acceptance of both the medium and light yolk eggs.

Providing Choice of Yolk Color Should Increase Demand.

If consumers have opposing preferences for yolk colors, as this research indicates, it is reasonable to expect that the demand for eggs can be increased by providing a choice of colors to permit the expression of the different preferences. Whether or not this increase in demand will be sufficient to pay the cost of differentiation is outside the limits of this study. It is assumed that there is no inherent difference in the costs of producing light, medium, or dark yolk colors. The additional cost would be limited to the cost of labeling and the cost of inventory control problems associated with keeping the proper number of choices before shoppers. This is similar to the problems of inventory control for complementary substitutes of other products, such as red apples and yellow apples or different brands of coffee. It is suggested that this type of product differentiation presents a challenge to the egg industry that deserves further investigation and consideration. It seems apparent that if only one yolk color is to be offered in the market it should be quite close to the medium yolk color used in this study. However, it also seems obvious that eggs could be made more attractive to consumers by offering both lighter and darker colored yolks in the market and by identifying these colors by labeling the cartons to indicate the yolk color. It is possible that one color can be made acceptable to most consumers if it is a medium color and if promotional and educational efforts are made to change consumers' preference to make this color more acceptable. The proposed efforts to change preferences would involve costs to the industry. It would probably be only partially successful and thus result in some loss of sales to rival products. It is believed that the egg industry will be following a sounder course of action if a program is initiated that will permit consumers to purchase the yolk they prefer. Labeling the carton to tell the purchaser the yolk color of the eggs in the carton would facilitate selection of the desired color.

Uniform labeling of cartons would involve the development of a method of setting limits of variation for each color designation. It is suggested that the milligram equivalents of Beta Carotene test referred to in this study could be used to define these limits. A market experiment could be developed to test the effectiveness of two different marketing programs. It is suggested that one of the programs use three color designations and the other two. The three colors suggested are:

Lemon yellow yolks, 15-29 milligram equivalents,
Light orange yolks, 30-44 milligram equivalents,
Orange yolks, 45-60 milligram equivalents.

The alternate plan for two yolk colors would consist of:

Yellow yolks, 20-35 milligram equivalents,
Orange yolks, 45-60 milligram equivalents.

It should be noted that in the plan for three yolk colors the scale is continuous from 15 to 60 milligram equivalents. In the plan for two colors there is an area of 10 milligram equivalents between the two colors that would not qualify for either color designation. This lack of consistency between the two suggested plans is introduced to call attention to a specific problem. The problem is that if the scale is continuous there will be a strictly arbitrary line between the color designations. Casual observation cannot distinguish between the colors that are very close to the line but on different sides and, therefore, different colors by definition. At the same time, it will be obvious to most observers that colors near the extreme ends of the the same color designation are different. On the other hand, a wide enough gap to assure that each color designation can be distinguished from the other by observation or comparison would create the very serious problem that the colors between could not be put in either classification. This problem of continuous versus interval color scales is not related to the problem of whether to use two or more than two-color designations.

It is suggested that if a color label on consumer grade eggs were made mandatory, the color designation scale should be continuous over the area covered by consumer preferences. Extremes at each end of the scale could be excluded from sale as consumer grades. Those that fell between these arbitrary extremes would qualify for one of the consumer color designations. However, if color labels are optional for marketing organizations, a scale with intervals between the designated color names could be used. If the egg carton carried a color designation label, it could be made mandatory that only certain designations or terms be used to describe color. These designations could be rigidly defined and the specifications could be divisions between designations at a specific point on the continuous scale, or the scale could contain intervals between color designation that would be wide enough that one color could be distinguished from another. Eggs with yolk colors that were in the intervals could be sold as consumer grades without color designations as eggs are sold now.

Color designation is essentially a problem of adequate product labeling. Consumers do have different preferences for yolk color but under present packaging and labeling conditions they have very limited means of choosing them in the market place. It is suggested that under present marketing procedures consumers with strong color preferences may find the colors they prefer through trial and error and continue to purchase from sources that give them that color consistently. If this situation applies to a substantial number of consumers, many market organizations may be selling differentiated products without knowing

that consumers differentiate among eggs on the basis of yolk color associated with a particular source of supply.

Only tests in specific markets can show precisely what color designations are practical for the egg industry to adopt and how these designations can be used to maximize sales. However, the results in this study indicate that the problem exists and the results of many other studies support the findings. Consumers have opposing preferences for yolk color, and data were cited to show that these opposing preferences have existed in similar magnitudes in many markets over the last 30 years. As long as these opposing preferences continue to exist, the egg industry will be handicapped in competing with rival producers unless it can find an effective means of differentiating between eggs with different yolk colors so the consumers with different preferences can choose the color they prefer.

Uniformity Did Not Determine Evaluation.

Cartons containing one-half dozen eggs from the Grade A group and one-half dozen from the Grade B group were given to each of the households to use and evaluate. The mean scores of these cartons of mixed A and B grade were below the scores of Grade A cartons and above the scores of Grade B cartons. The same households were also given a carton of eggs containing six medium orange colored yolks and six light lemon yellow colored yolks. The mean scores of these cartons were below the mean scores of the cartons containing uniform orange colored yolks and above the mean scores of the cartons containing uniform light lemon yellow yolks. The results indicate that grade and yolk color are each more important than uniformity of the attribute itself. This evidence contradicts a widely held opinion that uniformity of yolk color is more important than the shade or intensity of color.

Taste and the Presence of Blood Spots Were Factors in Evaluation.

Comments on taste or flavor occurred more often than any other class of comments except stand-up. No attempt was made to evaluate these comments, but it is believed that the respondents sometimes associate taste with the controlled variables, grade, and yolk color. Other research has shown a positive but imperfect correlation between grade and taste. The relationship between yolk color and taste is not known. It is suggested that the relationship between taste and other attributes deserves further attention from the egg industry.

Failure of the procedures used in this study to control the presence of blood spots emphasizes the difficult nature of this problem for the entire industry. It is believed that the procedures used were at least as effective as those usually used in the industry. Inspection of the comments on the weekly schedules and on the terminating interview supports this belief. Failure of the industry to eliminate this defect from the product is believed to be a deterrent to the maintenance of a strong demand for eggs. Statements from respondents show that 63

percent of the 38 respondents who received unacceptable eggs found them unacceptable because of blood spots.

Some Respondents Objected to Eggs That Were Thought To Be Fertile.

There was also evidence that some consumers were concerned about fertility in the eggs they use and that some of them associate the presence of a conspicuous chalaza with fertility. However, none of the eggs were fertile. The study was not designed to explore this problem and no procedure was discovered to evaluate its importance.