

RESEARCH BULLETIN 835

AUGUST, 1963

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE

AGRICULTURAL EXPERIMENT STATION

ELMER R. KIEHL, *Director*

Visual Preferences for Interior Egg Quality

LLOYD D. BENDER AND LEONARD A. VOSS



(Publication authorized August 26, 1963)

COLUMBIA, MISSOURI

CONTENTS

Summary and Conclusions	3
Introduction	4
Purpose and Objectives	5
Procedures	6
The Preference Situation	7
Schedule Design and Administration	7
Consumer Comments on Attributes	9
First Choices and Comments	11
Analysis of Variance of Ratings	13
The Significance of Color	14
The Relative Importance of Attributes	15
Acceptability of Attribute Variations	19
Significant Differences Between Grade Means	19
Répeatability of Preference Results	20
Discussion and Implications	21
Literature Cited	23
Appendix	25

This publication is a report on Department
of Agricultural Economics research
Project 382, "The Relation of
Egg Quality Criteria to
Consumer Acceptability
of Eggs"

Visual Preferences for Interior Egg Quality

LLOYD D. BENDER AND LEONARD A. VOSS

SUMMARY AND CONCLUSIONS

The purpose of this study was to determine the basis for consumer's choices among eggs with different internal characteristics. Consumer's views of internal egg quality can be defined if (1) the attributes consumers use to judge eggs and (2) tolerance of attribute variations are known.

Data came from multiple stage probability samples in Marshall and Windsor, and St. Louis, Mo. In Marshall and Windsor, 190 schedules were completed and in St. Louis 378 complete interviews were conducted.

Statements by consumers of what was liked or disliked about a display of three broken-out eggs were obtained first in the preference situation. The broken-out eggs were prepared to be representative of United States Department of Agriculture grades A, B, and C. After comments had been made, consumers were asked to rate each of the eggs on a 0 to 9 rating scale. A rating scale was used because ratings (1) do not force consumers to choose between eggs, (2) can be obtained without implying one egg is better than another, and (3) can be analyzed more fully than rankings.

The comments made by consumers were interpreted as being indicative of the internal attributes used by consumers to judge eggs. Consumers generally liked a thick albumen, a high yolk, chalaza which were not prominent, and a definite yolk color. References were made to the yolk, either because of its shape or color, more than to any other attribute. The experimental design, however, was not meant to include yolk color and no rigorous analysis of color was made. An awareness of the chalaza resulted in strong statements of dislike of the attribute although consumers were factually misinformed concerning the function of the chalaza.

Mutually exclusive groupings of consumers were formed on the basis of the major comments regarding internal egg characteristics because interactions between comments had resulted from an analysis of variance. The groupings of consumers were made on the basis of comments relating to: (a) the chalaza regardless of other remarks, (b) albumen thickness and yolk shape, (c) the albumen only, (d) the yolk shape only, and (e) no comment on albumen thickness or yolk shape. The proportion of respondents in each group provided an indication of the market significance of each attribute.

The ratings of each egg indicated how much the attributes of the egg were liked. There were statistically significant differences among groups of consumers making different comments. Consumers aware of the chalaza (regardless of other attributes) rated the grade A display egg lower than other consumers. The grade B and C display eggs were rated lowest by consumers using albumen thickness as a judgment criteria, in between by those commenting on the yolk, and highest by consumers not commenting on either the yolk or albumen, and by those objecting to the chalaza. The range of the mean B and C ratings was large. Differences depended on the attributes consumers used to distinguish between eggs.

A significant difference between mean ratings of the A and B display eggs existed only for those two consumer groups that commented on albumen thickness. These two groups comprised 47 percent of the sample population in St. Louis. No significant differences were found between A and B mean ratings by the other three consumer groups, which represented 53 percent of the St. Louis sample. Significant differences were found between the B and C mean ratings for these three groups.

The implications are that (1) albumen thickness could be used as the attribute on which to base one grade and (2) yolk height and the prominence of the chalaza cords could be the bases of another grade. Each grade might be allowed to overlap the other since each would be based upon different attribute criteria.

The grade using albumen thickness as the standardization criteria should be designed to meet the preferences of consumers who use that criteria to judge eggs. Since this group of consumers did distinguish between the A and B display eggs, the boundary for the grade should presumably be within this range. A grade with this amount of variation in albumen thickness also would be acceptable to consumer groups with a tolerance for variations in albumen thickness.

Another grade using yolk height as a criteria for standardization should be designed to meet the preferences or tolerances of consumers who use the yolk or chalaza as judgment criteria, or neither the yolk or albumen for criteria. The fact that 53 percent of the respondents in the St. Louis sample did not distinguish between the A and B display eggs but did between the B and C eggs indicated the yolk boundary should lie between the B and C grades.

The justification for a second grade using yolk height as an index of the grade boundary is that (1) consumers use the yolk and presence of the chalaza as a judgment criteria, (2) the cost of producing, handling, and marketing this grade might be significantly lower, and (3) consumers can be offered a choice.

INTRODUCTION

The egg quality problem has evolved to determining what consumers desire and producing for those desires rather than simply segregating heterogeneous items into more homogeneous lots or standardizing industry terminology.

The large specialized and integrated egg production-marketing units developing throughout the United States are in an ideal position to control the variation of egg attributes in the production process as well as throughout the marketing system. Even within United States Department of Agriculture grade boundaries, egg production-marketing firms should be able to "design" qualities tailored to meet the particular desires of consumers if those desires are known to the firm.

The first nationwide standardization of egg quality originated in 1925 with the adoption by the Department of Agriculture of egg grading standards. Prior standards were apparently designed to facilitate trade between the widely separated production and consumption areas. The classification terms used by the trade were indicative of the locality of production or other characteristics. A multiplicity of identifying terms, such as Midwestern Extras, Pacific Coast Whites, and Nearby Henney Whites, had introduced confusion and misunderstanding in interregional trade (20, 31).

Grade standards for eggs have been revised or re-evaluated every four or five years since 1925 but have remained essentially the same (20). Changes in production and marketing technology and business organization have prompted the adoption by the U. S. Department of Agriculture of a "Quality Control" program designed for large lots in addition to the grades previously promulgated for individual eggs (11).

Standards for individual shell eggs are based upon the consistency of the thick albumen, freedom from interior defects such as blood and meat spots, and shell abnormalities (21). Requirements for the "Quality Control" program include a detailed break-out sampling of albumen height, plus candling for interior defects and handling requirements rigidly designed to maintain albumen consistency throughout the marketing system.

The need to tailor product standardization to the desires of consumers would appear to be most important for eggs regardless of whether the standardization is accomplished by firms or by government grade standards. Not only are eggs highly perishable, but they are also bought without consumers having a direct way to determine quality from the product itself at the time of purchase. As a consequence, consumers must rely on (1) the reputation of the retailers, (2) grades or brand designations for prediction of product repeatability, or (3) assume some risk of dissatisfaction, however great or small, with each purchase.

Two phases of one project to determine consumer preferences for interior attributes of shell eggs were initiated with different methodological approaches. The first phase used an approach designed to study consumer choices when all relevant attributes and attribute variations were presented visually to consumers in one preference situation. The second phase, reported by Banks and Voss, used a methodology simulating normal household use. (2)

PURPOSE AND OBJECTIVES

The purpose of this study was to develop bases for consumer choices of eggs in such a manner that quality, and quality norms, could be defined more

precisely. The results of this study can be used by firms in the industry or by government agencies to promulgate the attributes associated with standardization and the range of variation in those attributes which is desirable to (a) control the quality produced, (b) maintain quality in marketing channels, or (c) divide heterogeneous lots into more homogeneous groups.

The following procedure, adapted from Oxenfeldt, is necessary to develop standardized products meaningful to consumers (18):

1. Isolate the attributes of the product which are important.
2. Assign relative weights to each attribute.
3. Determine the ranges of attribute variation acceptable to consumers.
4. Select technical methods of measuring the attributes.
5. Determine the reasons for variations in the attributes and control the variations.

Steps four and five are beyond the scope of this study, although technical methods of attribute measurement and the variables associated with attribute variability of eggs have been well defined.

Steps one through three above are within the scope of this study. The specific objectives of this study are to:

1. Isolate all of the major attributes important in consumers' choices of egg interiors.
2. Determine the proportion of the population using each interior attribute in order to assess the relative market importance of each attribute.
3. Determine how the variations of attributes affect choices.

PROCEDURES

The data for this study were generated in surveys in Marshall and Windsor, and St. Louis, Mo. A pretesting procedure initiated in Columbia, Mo., resulted in valuable insights related to procedures and analysis, although the results are not covered in this report (6). Forty-nine cooperators selected by random procedures in Columbia participated in three different interviews each in pretesting (a) a rating scale, (b) the use of broken-out eggs (c) multiple- and single-stimulus techniques and (d) hypotheses related to preferences. The Marshall-Windsor survey of 190 completed single interviews was conducted to obtain representation from non-metropolitan cities in a rural setting, and to completely check final procedures. Schedules from 378 respondents were completed in St. Louis.

Procedures in the St. Louis and Marshall-Windsor surveys were identical except for sampling details. A multiple stage probability sampling technique was used for both surveys and almost identical interview techniques were used, although the interviewing was completed at different times of the year and a different set of interviewers was used in the two surveys. The description of procedures in this report is made without respect to the area.

The Preference Situation

The preference situation consisted of a display of three eggs broken out in coded paper plates. Comments on attributes and ratings were obtained on each egg. The use of more than one object with variations in the composition of the objects is called a multiple-stimulus display. A reaction obtained while consumers view a product is called a visual preference situation in contrast to actual preparation and consumption of the product in normal household use.

The visual preference situation and multiple-stimulus technique were chosen for this first study of the project in order to obtain consumer reactions when consumers were most likely to be aware of the internal attributes of eggs. Presenting all relevant variables at one time produces the most consumer awareness of attributes possible without directly calling attention to particular attributes. For this reason, the method can be described as producing a "maximum potential state of awareness." It was assumed that a reaction to an attribute in this situation would produce the same reaction in normal household use *only if the same degree of awareness of the particular attribute existed*. Pretesting, for instance, produced a reaction against the chalaza when it was noticed, but it is not known how many consumers become aware of the chalaza while preparing eggs for breakfast.

Broken-out eggs were used in this study. Most of the previous studies of consumer preferences for eggs had used photographs as a basis of either discussion or choices of eggs with different internal characteristics. Kohls and Taylor, in separate studies, varied this procedure by using broken-out egg displays (15, 28). A most striking difference between choices and comments from pictures and broken-out eggs was found by Stadelman in a second study. He found that consumers evaluated eggs on the basis of yolk height and the presence of the chalaza as well as on albumen height (27).

The use of broken-out eggs in the preference situation presented a problem of controlling the internal characteristics of the display eggs. The poultry department prepared eggs representing the range of interior attributes of the U.S.D.A. grades A, B, and C. Eggs were gathered from hens of the same breeding on a controlled ration. The eggs were sized and candled carefully, and then were subjected to a controlled environment to produce the range of internal attributes desired. At the end of the period of controlled environment the eggs were candled at room temperature. The candled quality averaged high A, medium B, and high C. (Fig. 1). A sample of eggs taken at the end of the day from the iced supplies used in interviews indicated these qualities had been maintained adequately throughout the interview period. Any variability in egg yolk color was the result of individual hen differences because the same feed and hens were used to produce all of the display eggs.

Schedule Design and Administration

The general arrangement of the schedule placed the preference situation near the beginning of the interview. Questioning in the preference situation utilized

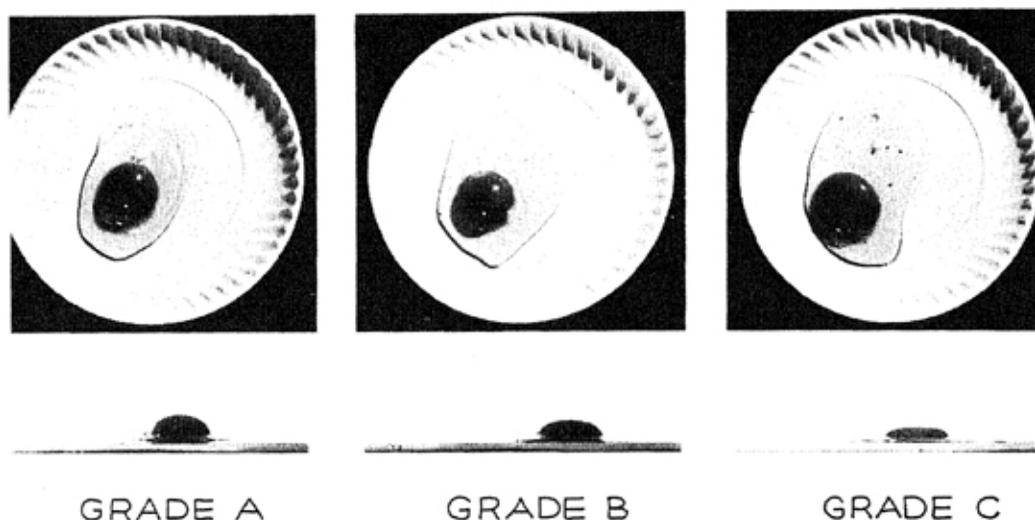


FIGURE 1. Average A, B, and C Grades of Broken-out Eggs

the open-ended technique as much as possible. The preference situation itself involved the first questions related to eggs and egg characteristics. It was recognized that the positioning of the preference situation could influence the results. All questions related to purchase habits, grade meanings, and dissatisfaction were purposely asked after the preference situation.

Open-ended questioning was used in the preference situation to prevent the introduction of question bias. Respondents were first asked to examine three broken-out eggs and comment on anything which was liked or disliked about any of them. The interviewer was cautioned not to be solicitous when asking for comments, to record comments as nearly as possible in the words used by the respondent, and to terminate the comment phase when it became obvious all comments had been made. In two instances the interviewer was asked to probe further. If a respondent mentioned spots on the egg, the interviewer asked which spots. Pretesting had revealed respondents may be referring to the germ spot or to the chalaza as well as meat or blood spots when this comment is made. In St. Louis if a respondent commented about how the egg stood up, the interviewers asked in what way the egg stood up in search of a reference to the yolk or the albumen. The Marshall-Windsor tests had indicated different choice patterns were dependent upon a yolk or an albumen comment.

Ratings of each display egg were obtained on a 0-9 rating scale after all comments had been made. Interviewers were asked to interpret the rating scale in the following manner:

The rating scale may be thought of as a thermometer. The higher the number, the higher the degree of acceptance. A zero would designate an egg as unacceptable to you. If you rate an egg zero, you would not use it for that purpose and would throw it away. Any number from one through nine means you would use

the egg, but the higher the number the better you would like the egg for that purpose. An egg which is rated nine means that egg is acceptable to you and if you were to purchase that type of egg at the store, you would return and buy the same egg and be entirely satisfied with its use.

This interpretation was made while the scale was being shown to the respondent in an attempt to minimize variations in rating scores due to individual differences in use of the rating scales.

A rating scale was used to record choices in spite of the fact that every study reviewed had used rankings as the method of recording choices. Aside from the fact that analyses of rankings are limited, rankings force consumers to show differences whether the differences are important or not, and the differences between ranks are always the same for every person. While one person may react violently to an object and rank it second as a result, another person may rank the same object second although no real difference exists for him. The ranking also limits a measurement of the relative importance of one attribute out of the many which may influence choices. Ratings allow individuals to distinguish relative differences between objects and permit a much wider range of analyses. Ratings can also be transformed into weakly ordered rankings if that type of an analysis is particularly desired.

CONSUMER COMMENTS ON ATTRIBUTES

Respondent awareness of internal egg characteristics was standardized as much as possible with the display of three eggs showing variations in internal characteristics. If consumers are not aware of interior egg characteristics in this type preference situation, then it is not likely they will easily become aware of attributes in normal household uses of the product. The usefulness of the comments is in the development of hypotheses about behavior. The problem becomes one of (a) determining awareness of attributes and then (b) responses to those attributes.

The simple tabulation of comments provides an indication of how many consumers became aware of the attributes in the preference situation rather than whether those attributes produced some consumer response. Interpretations directly from comments must be made with the additional recognition that (a) consumers were allowed to make more than one comment, (b) the comments recorded may not have applied directly to eggs in the display, and (c) the criteria used by consumers may not have been reflected in their comments.

The interior attributes mentioned most frequently were the albumen thickness, yolk shape, yolk color, the chalaza cord, and the manner in which the egg stood up (Table 1). Almost one-fifth of the respondents interviewed in St. Louis made no comment related to the above criteria although any number of minor comments were made. Most consumers making a response mentioned more than one internal egg characteristic.

TABLE 1 - PERCENT OF RESPONDENTS COMMENTING ON SELECTED EGG CHARACTERISTICS, MARSHALL - WINDSOR AND ST. LOUIS

COMMENT	Marshall - Windsor	St. Louis
Albumen Thickness	57.9	54.8
Yolk Shape	42.1	51.3
Yolk Color	27.9	32.5
Chalaza Presence	13.2	21.4
Stand-Up	34.7	13.0
Albumen Clearness	a	12.7
Freshness	a	11.1
Broken Yolks	a	8.7
Size	a	6.9
Spots	8.4	6.1
Firm Egg	a	5.6
Other	a	4.0

^aThe comment was not made, or was classified differently.

The responses to the display can be placed in positive and negative categories, depending upon whether the characteristic was liked or not. A thick albumen and a yolk that stood up were generally like by respondents mentioning these characteristics. References to the chalaza or prominence of the chalaza cords were expressed as a dislike and respondents usually made references to the chalaza as a spot or as evidence of fertility. Strong beliefs about the function and presence of the chalaza cord were expressed although the correct function of the chalaza in the egg was not known to most consumers. Reactions of consumers to an attribute, however, are on the basis of what is believed rather than what is true.

The Marshall-Windsor survey had revealed that references to how the eggs stood up could mean how the yolk stood up or how high the albumen stood up. In an attempt to classify this comment in the St. Louis survey consumers were asked to distinguish what part of the egg stood up when this comment was made and to record the comment as relating to the specific attribute. The

differences in the proportion of respondents commenting on yolk shape and stand-up in Marshall-Windsor and St. Louis could be attributed to this change in interview technique.

References to yolk color were made by a significant proportion of the respondents in both surveys although this attribute was controlled as closely as possible when the eggs were produced. It is not known whether distinguishable differences in color were actually evident to consumers, or whether the color comment originated from previous experiences with eggs. It appeared to be important enough to warrant further study and was incorporated in the second phase of the project and reported by Banks and Voss (2).

First Choices and Comments

The proportion of respondents aware of an attribute in a given preference situation and the reaction to that attribute must be determined in order to assess the importance of attributes to choice. Past studies associating albumen height with first choices indicated this variable alone was not satisfactory. The apparent reason given by a majority of consumers choosing grade A in past studies was associated with albumen height but the choice of grade B or C with albumen height given as one reason did not appear consistent. Taylor noted that "a considerable proportion failed to select the egg as 'best' to which the reason given applied" (28). Baker and Goldman stated "their reasons and the egg they picked were inconsistent" (1). Owens and Taylor concluded that knowledge inferences based upon the consumer's selection were superficial (17).

The findings of Stadelman and the pretesting for this study indicated yolk shape and the chalaza were associated with choices other than grade A (27, 6). The Columbia pretest also indicated consumers were quite consistent in making the same choice in repeated trials and this result appeared to indicate a logical set of criteria was used to make choices.

The results of cross tabulating first choices, as determined from the rating scores, and the comments from the Marshall-Windsor survey seemed to confirm the results of previous studies (Table 2). Albumen thickness, yolk shape, and stand-up comments appeared to have dominated the A and B first choices. The proportion of respondents commenting on the chalaza was highest for those choosing grade C first. Tied A-B choices appeared to be made on the basis of yolk shape rather than on the chalaza.

The apparent inconsistency of choices and reasons for choices mentioned in other studies are shown by these data. A large proportion of consumers choosing the grade B also mentioned albumen thickness. If it is assumed consumers are logical, then the explanations for such an apparent inconsistency can be (a) some consumers prefer something less than maximum albumen height, (b) more reliance was placed on yolk shape, (c) other criteria were more important than albumen thickness, or (d) the comments were not complete. The very small number of respondents in the minor choice categories prevented a more rigorous analysis of these data.

TABLE 2 - PERCENT OF RESPONDENTS COMMENTING ON SELECTED INTERIOR EGG CHARACTERISTICS BY FIRST CHOICE, MARSHALL - WINDSOR

Consumer's First Choice ^a	Number of Consumers	Interior Egg Characteristics				
		Albumen Thickness	Yolk Shape	Yolk Color	Stand-Up	Chalaza
Percent of Respondents						
A	104	69.2	44.0	26.0	42.3	6.7
B	33	66.7	45.5	42.4	50.3	24.2
C	11	18.2	9.1	9.1	27.3	45.5
Other	23	26.0	34.7	34.7	26.0	13.0
No Score	19	42.0	26.3	15.8	15.8	10.5
TOTAL	190	57.9	42.1	27.9	34.7	13.2

^a First choices were determined from the highest rating score and could be tied. If no rating was given to the display eggs, then first choice was tabulated as no score.

TABLE 3 - PERCENT OF RESPONDENTS COMMENTING ON SELECTED INTERIOR EGG CHARACTERISTICS BY FIRST CHOICE, ST. LOUIS

Consumer's First Choice ^a	Number of Consumers	Interior Egg Characteristics				
		Albumen Thickness	Yolk Shape	Yolk Color	Stand-Up	Chalaza
Percent of Respondents						
A	182	67.0	58.8	32.4	18.1	14.8
B	86	52.3	59.3	38.4	9.3	36.1
C	31	51.6	51.6	48.4	9.7	22.6
Other	69	27.5	24.6	23.2	7.3	20.3
No Score	10	50.0	30.0	--	--	20.0
TOTAL	378	54.8	51.3	32.5	13.0	21.4

^a First choices were determined from the highest rating scores and could be ties. If no rating was given to the display eggs, then first choice was tabulated as no score.

An analysis of first choices and comments from the St. Louis data failed to reveal a clear pattern of relationships for all first choices (Table 3). A high proportion of the respondents chose the grade A egg first and a high proportion of the respondents also made a comment on albumen thickness. The proportion of those selecting the A first and also commenting on albumen thickness, yolk shape, or stand-up was also high. A larger proportion of those selecting the grade B and C first made comments on the chalaza and yolk color and fewer mentioned how the egg stood up, but many also made albumen and yolk shape comments. Respondents choosing some tie combination of A, B, and C had a much lower comment rate than other respondents, and no distinguishable pattern was evident except for a high proportion of chalaza comments relative to other remarks. The apparent inconsistencies also were evident in the association of first choices and comments from the St. Louis data.

A Chi-square test for each comment group was computed to test the hypothesis that choice and the comment were independent since a pattern of relationships was not readily evident in the St. Louis data. Commenting or not commenting on an attribute affected first choices since the Chi-square values were significant at the 1 percent level for albumen thickness, yolk shape, and the chalaza, and at the 5 percent level for yolk color. No patterns other than those previously described can be presumed to exist, however, because of the rejection of the independence hypothesis. Further analysis of the rating scores for differences in means or variance for groups of consumers making selected comments was encouraged by the rejection of the independence hypothesis.

Analysis of Variance of Ratings

Analyses of variance of the St. Louis data indicated sources of significance within the grade A scores due to color and chalaza comments. There was significance due only to albumen thickness in the grade B scores. The sources of significance in the grade C scores were due to albumen thickness and yolk shape and interactions between albumen-yolk and albumen-color. First order interactions were much more prevalent in the Marshall-Windsor data than in the St. Louis data. No attempt was made to introduce grade differences into the analyses of variance at this point.

The analysis of variance could only be interpreted as a preliminary step made toward identifying sources of significance. The cells in the analysis of variance problem were unequal in size, some containing a very small number of observations, and it was necessary to use the method of unweighted means in calculating significance. The interactions obtained in many places would not permit a rigorous interpretation to be placed on sources of significance. A procedural difficulty was also involved because the respondents who did not make a comment on the attribute categories used could not be included in the analysis of variance. Had a *no comment* grouping been included in addition to color, a number of vacant cells would have existed and cell sizes would have been extremely small.

The Significance of Color

The significance due to the color comment continued to be puzzling since no variations in color were planned in the display eggs. A hypothesis that there was a bimodal distribution of scores within the color comment group (4) was tested. The logical basis for the hypothesis is that if consumers liked the color being displayed their rating scores for all grades would be higher than the scores of those who did not like the color being displayed; that is, the group of consumers commenting on color and rating the A grade higher than average should have rated the B and C higher than average.

A graphing of scores in this manner proved this was not the case. Those who commented on color and rated the A grade higher than average for the group did not rate the B and C grade eggs higher than the average for the group. The interaction between albumen and color could have prevented a pattern of bimodality from being evident.

The effect of consumer awareness of color was a moderation of the ratings of the A and C display eggs. In every case consumers who mentioned color rated the A and B display eggs lower and the C higher than consumers making the same set of comments but not mentioning color (Table 4). This interaction of

TABLE 4 - THE EFFECT OF COLOR AWARENESS ON RATINGS OF GRADES A, B AND C EGGS WITHIN EACH MAJOR COMMENT GROUPING, ST. LOUIS^a

Grade	Color Comment	Comment Group			
		Albumen and Yolk	Albumen Thickness	Yolk Shape	No Albumen or Yolk
A	Color	6.72	6.74	7.16	7.11
	No Color	7.34	7.95	7.68	7.35
B	Color	4.61	5.08	6.68	6.73
	No Color	5.30	6.51	6.96	7.02
C	Color	3.00	3.78	3.94	6.28
	No Color	2.73	2.81	3.60	5.52

^a Excluding all consumers commenting on the chalaza.

the color awareness and awareness of other attributes illustrates the sources of significance obtained in the preliminary analysis of variance. Of 103 consumers in the St. Louis sample who mentioned color, 39 also mentioned albumen and yolk, 27 mentioned only the albumen, 19 mentioned only the yolk, and 18 did not mention albumen or yolk. This distribution of comments among the respondents mentioning color was very close to the distribution of comments of those who did not mention color.

THE RELATIVE IMPORTANCE OF ATTRIBUTES

An exclusive grouping system for respondents by comments was made for further analysis on the basis of preliminary analyses of first choices, analysis of variance, and patterns of mean rating scores. The color comment was dropped from the analysis in this study because no norm or measurement of color had been made and no statements of exact color preferences had been obtained in the interviews.

The following exclusive groupings of consumers were defined:

- A. Respondents who reacted to the chalaza regardless of other comments.
- B. Respondents who commented on albumen thickness and yolk shape.
- C. Respondents who made a comment about the albumen thickness only.
- D. Respondents who commented about the yolk shape only.
- E. Respondents who made no comments about albumen thickness or yolk shape.

An exclusive grouping of consumers in this manner assumes that the particular set of comments used will determine reactions to eggs. Many minor comments, as well as the yolk color comment, were disregarded. Tests of significance between consumer groupings and grades were computed by pooled variance since each consumer classification was mutually exclusive, and significance signifies either a difference between means or population differences.

The proportion of respondents in each exclusive grouping for both samples is given in Table 5. If the reaction of one group is different, then the proportion of the total population in that grouping would provide an indication of the relative market importance of the attribute. The strong negative reaction to the

TABLE 5 - PERCENT OF RESPONDENTS IN MUTUALLY EXCLUSIVE COMMENT GROUPINGS, MARSHALL - WINDSOR AND ST. LOUIS

Comment Group	Marshall - Windsor	St. Louis
Albumen Thickness and Yolk Shape	49 ^a	29
Albumen Thickness Only	17	18
Yolk Shape Only	12	13
No Comment	9	18
Chalaza	13	22
TOTAL	100	100

^a Not exactly comparable with St. Louis because this proportion includes those respondents making a "stand-up" comment and not excluded by a chalaza response while this method of tabulation was not used for St. Louis data.

chalaza, for instance, would seem to indicate that this particular attribute affected the choices of more than one-fifth of the sample population.

The average rating scores for each grouping revealed some very definite patterns (Figures 2 and 3). The differences between the A and B, and A and C ratings are progressively smaller for the groups commenting on (a) albumen and yolk, (b) albumen only, (c) yolk only, and (d) no comments. The A rating was approximately the same for each of these groups but the B and C ratings increased progressively. The mean ratings by exclusive groupings seem to bear out the preliminary findings from the analysis of variance.

The most important pattern was revealed for the chalaza comment group. The mean ratings for the grade B egg were greater than the mean A rating. The tabulation of first choices and comments indicated this result might be obtained

Mean
Rating

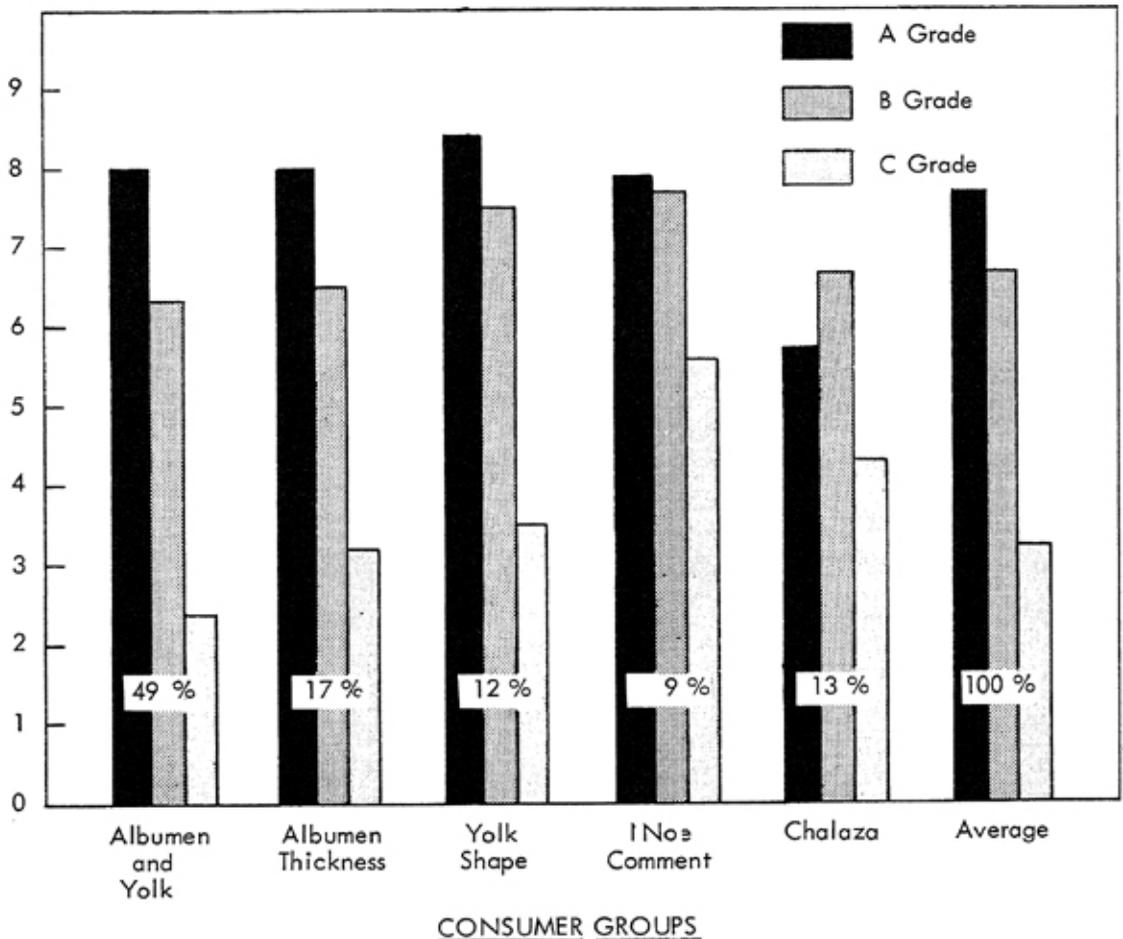


Fig. 2 - Mean Rating Scores for Grade A, B, & C Display Eggs by Consumer Groups, Marshall and Windsor

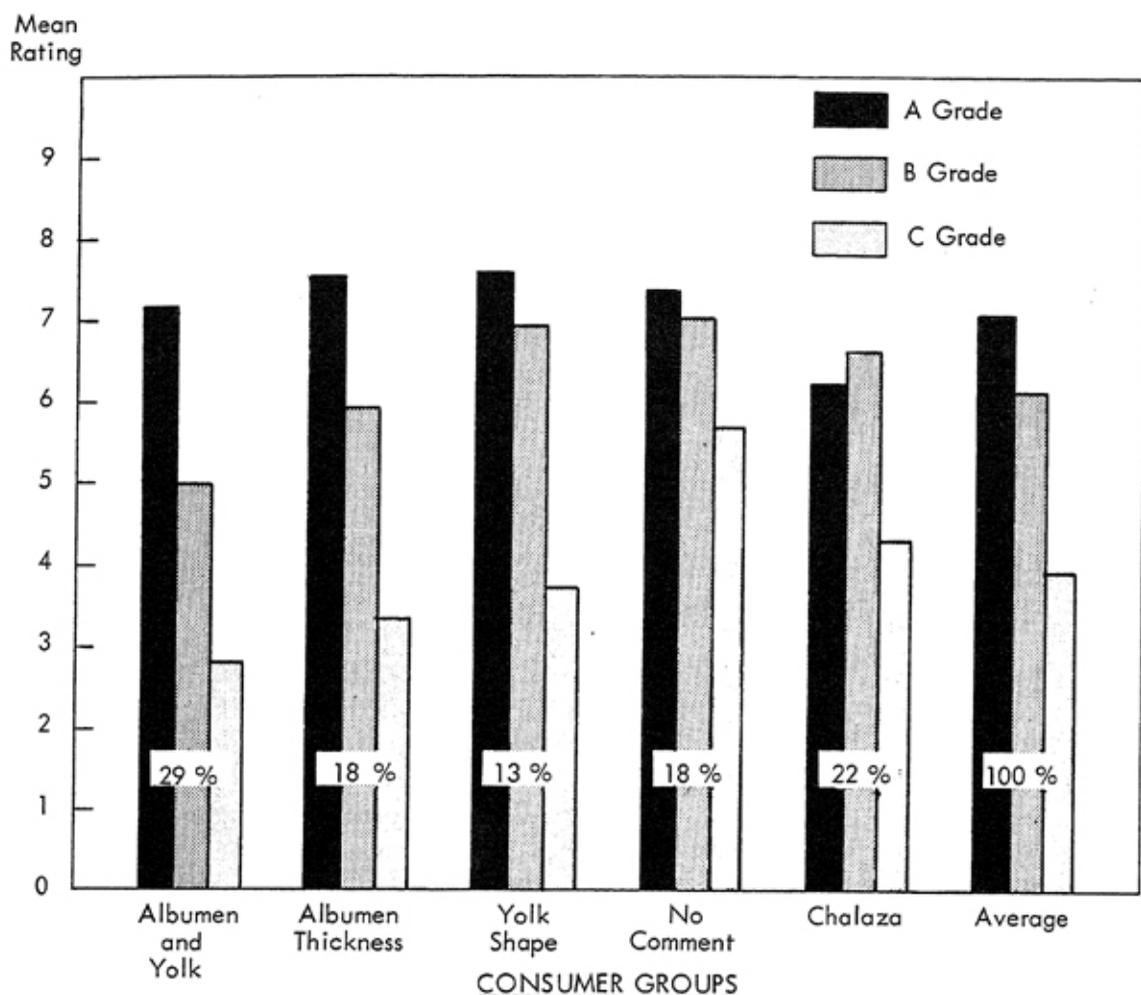


Fig. 3 - Mean Rating Scores for Grade A, B, & C Display Eggs by Consumer Group, St. Louis.

since such a high proportion of those selecting the B, C, or some tie of A, B, and C made the chalaza comment. If the same level of awareness of the chalaza existed in normal household uses of eggs, then a large proportion of consumers could be expected to actually prefer grade B over grade A.

The greatest difference between means within the grade A ratings was for the consumer group commenting on the chalaza (Table 6). All other groups rated the A egg nearly the same. The rating of the group commenting on the chalaza was significantly lower than that of any other group, indicating that this group did not consider the A as acceptable. Since almost half of the respondents in this group had commented also on the albumen or yolk, the significant differences between this group of consumers and the other groups indicate that an awareness of the chalaza is a dominant factor determining their preference and that the chalaza is more important than the other egg characteristics considered. If consumers did not become aware of the chalaza in normal household use, then other egg characteristics would probably assume a dominant importance.

TABLE 6 - MEAN RATINGS AND DIFFERENCES BETWEEN MEANS OF EXCLUSIVE CONSUMER COMMENT GROUPS WITHIN GRADES A, B, AND C, ST. LOUIS

Grade	Comment Group	Mean Rating	Comment Group			
			Albumen	Yolk	None	Chalaza
A	Albumen and Yolk	7.11	0.34	0.36	0.17	0.94*
	Albumen Only	7.45	--	0.02	0.17	1.28*
	Yolk Only	7.47		--	0.19	1.30*
	None	7.28			--	1.11*
	Chalaza	6.17				--
B	Albumen and Yolk	5.06	0.86	1.79**	1.88**	1.57**
	Albumen Only	5.92	--	0.93	1.02*	0.71
	Yolk Only	6.85		--	0.09	0.22
	None	6.94			--	0.31
	Chalaza	6.63				--
C	Albumen and Yolk	2.83	0.42	0.91	2.92**	1.52**
	Albumen Only	3.25	--	0.49	2.50**	1.10*
	Yolk Only	3.47		--	2.01**	0.61
	None	5.75			--	1.40*
	Chalaza	4.35				--

* Significance at the 5 percent level and ** at the 1 percent level determined by pool variance.

The lowest mean ratings given the grade B egg were those given by respondents who used both the albumen and yolk or the albumen only as criteria for judgment (Table 6). The difference between the albumen and yolk comment group and all other groups, except the albumen only group, was significant at the 1 percent level, indicating that the group using these criteria considered the B grade less acceptable than other groups. There was also a significant difference at the 5 percent level between the albumen only group and the group making no comment. The mean differences between the albumen only and all other groups were large but not significant.

The sources of significant mean differences of grade C ratings were attributable to the group making no comments and the group commenting on the chalaza (Table 6). Consumers using none of the major criteria discriminated less against the grade C egg than all others. This fact provides an indication that this grouping considered no other criteria.

ACCEPTABILITY OF ATTRIBUTE VARIATIONS

The market significance of each of the major attributes of eggs can be estimated since three of the five consumer groupings resulted in significantly different ratings within grades. The percentage of respondents in each grouping should be indicative of the market importance of each of the attributes used to classify consumers. Product standardization, however, is based upon the amount of tolerance to variations in each of these attributes; in this study, an indication of tolerance is provided by the rating differences between grade A, B, and C eggs for each consumer grouping.

The acceptability of attribute variations in any product depends upon both the attributes consumers use to evaluate the product and the variability of the attributes themselves if consumers do consider the attribute important. From a consumer's standpoint, a preference may be expressed for a particular characteristic and some variation of that product characteristic. Variability of an attribute may be acceptable to a consumer simply because that attribute is of no importance or because the consumer is tolerant of variation of an attribute that is important.

Significant Differences Between Grade Means

A significant difference between the rating scores for grade A and B display eggs was found only for consumers who commented on the albumen alone or the albumen and yolk (Table 7). Significance in this case means that there were

TABLE 7 - DIFFERENCES BETWEEN GRADE MEAN RATINGS BY EXCLUSIVE CONSUMER COMMENT GROUPS, ST. LOUIS

Between Grades	Comment Group				
	Albumen and Yolk	Albumen Thickness	Yolk Shape	No Comment	Chalaza
B and A	2.05**	1.53**	0.62	0.34	-0.46
C and B	2.23**	2.67**	3.11**	1.19*	2.28**
C and A	4.28**	4.20**	3.73**	1.53*	1.82**

* Significance at the 5 percent level and ** at the 1 percent level determined by pooled variance.

distinguishable differences in internal egg characteristics for this group of consumers representing 47 percent of the sample population in St. Louis. Since the A was rated higher than the B by this group of consumers, it can be said the internal characteristics of grade A were preferred over those of grade B eggs.

The lack of significant differences between the A and B display eggs for the 53 percent of the consumers who commented on the yolk, chalaza, or no characteristic indicates that variations in the internal egg characteristics of the A and B displays were not distinguishable, or that other variables masked the differences. The patterns of the rating scores and the known amount of variation in the yolk and chalaza of the display eggs indicate that the variations were acceptable to this group of consumers.

A significant difference in the rating means between the B and C display eggs for every comment grouping revealed that there is a distinguishable difference between the internal egg characteristics, regardless of what characteristics or whether any characteristic was mentioned. The same observation follows from the significant differences of mean ratings of the A and C display eggs.

The lack of discrimination between attributes of the A and B eggs (or the tolerance of attribute variations between the A and B eggs) seems logical for consumers commenting only on the yolk. The deterioration rates of the yolk and albumen are different so respondents using the yolk as a major criteria may have failed to have seen significant differences between yolks of the A and B display eggs (6B). The albumen height decreases rapidly at first and more slowly in subsequent time intervals while the yolk deteriorates more nearly in a linear relationship with time. The decrease in albumen height between and A and B egg is greater than the decrease in yolk height.

The ratings of the A and B display eggs for the chalaza comment group appear to have been a compromise between two criteria. The prominence of the chalaza in the A egg was enough to force greater tolerance of yolk and albumen variations. The B egg, therefore, was more acceptable to this group than any other group of consumers. The compromise did not extend to the grade C egg to the same degree since yolk and albumen variations of this magnitude became more important relative to the chalaza.

Consumers who made no comment regarding the albumen, yolk, or chalaza would not be expected to differentiate between eggs showing variations in these attributes. The pattern of rating scores for this group reveals this to be true in a general sense. This group did not rate the B significantly lower than the A display egg and there was less difference between the C and B, and C and A ratings for this group than for any other group.

Repeatability of Preference Results

The repeatability of the results from the Columbia pretest, the Marshall-Windsor survey, and the St. Louis survey lend validity to the findings. The pattern of the scores was identical in the three surveys when they were tabulated

on the basis of consumer comments (Appendix Tables 8, 9, & 10). The consumer grouping system was not only successful in isolating sources of variability, but was also successful as a means of showing identical patterns from otherwise heterogeneous data.

The clear implication is that preferences result not from consumers each evaluating every attribute of a bundle of attributes, but from evaluating some of the attributes as well as other factors associated with product use. In those cases where product attributes are not important to a consumer, preferences may be determined by factors not even directly related to the product characteristics.

Success in standardizing a product, therefore, is not in selecting one attribute from the many contained in or associated with a product, but in isolating the attributes which are important to significant proportions of consumers and designing standardization norms which reflect the heterogeneity of consumer desires. One product acceptable to many consumer groups or desires can be designed even though the desire for particular attributes and the tolerance of attribute variations may be dissimilar.

DISCUSSION AND IMPLICATIONS

The preference situation used in this study was designed to standardize consumer awareness of the internal characteristics of eggs. To the degree that standardization was successful, the preference situation produced a consumer reaction more critical than is likely to exist when consumers use eggs in the home. The preference situation, therefore, defines reactions to attributes at one extreme of an awareness continuum. Consumers using eggs as they normally do are less likely to be as aware of egg attributes and are less likely to be as critical as those consumers in this study because of the preference situation. Standardization norms determined under conditions representing a "maximum state of awareness" should be acceptable to the majority of consumers who are less aware of egg attributes and attribute variations.

Fine lines showing where an attribute variation became distinguishable to consumers cannot be drawn from the results of this study. The display eggs representing average U.S. Department of Agriculture grades A, B, and C were the benchmarks with a known amount of variation in internal characteristics. References to standardization norms can be made only by referring to the display eggs as benchmarks, and a difference between an A and B egg, for instance, does not show exactly where the norm boundary should be, only that it should be somewhere between the A and B benchmarks.

The fact that a consumer rated one egg different from another is interpreted in this study as an indication that some degree of difference did exist. A statistical difference in rating scores for a group of consumers means there is a high probability (95 percent) that the difference was not due to chance variations in individual uses of the rating scale but was due to the way consumers reacted to the

eggs. The lack of distinguishable differences in egg attributes for a group of consumers, however, cannot be determined statistically; it must be interpreted carefully from logical patterns in the rating scores and from the repeatability of results.

Results of this study lead to the conclusion that a large proportion of consumers are very discriminating with respect to egg attributes while the remainder are much less discriminating. The consumer groups expressing an awareness of albumen thickness as a judgment criteria would object to a lower albumen height than existed for the B display eggs and would be better satisfied with an albumen height boundary between the A and B rather than between the B and C. Statistically significant differences between the grade A and B means indicated that the attribute variation was distinguishable to this group of consumers. The lower rating scores for grade B indicated a preference for the attributes of grade A over grade B. Since this group of consumers represented 47 percent of the sample population in St. Louis, the market importance of albumen height was greater than that of any other single attribute.

A standardization boundary based on albumen thickness and defined as some albumen height between the present grades A and B would satisfy consumers who use albumen thickness as a criteria and would not be objectionable to the remainder of the consumer population except those becoming aware of the chalaza. The difference between the ratings of the A and B display eggs for the chalaza comment group, however, was not significant. It is not known whether the difference between the present AA and B eggs would result in a significant difference for this group of consumers.

There would be no need to have any standardization category other than that suggested above if the cost of producing, handling, and marketing eggs were the same regardless of what standards were adopted. If the wholesale cost of grade A and grade B eggs were the same, then the standard grade given above could be the only one specified for table eggs. If a difference in the cost of producing, handling, and marketing eggs with different standards does exist, then some firms might find it economically feasible to produce an egg with a greater attribute variability than that suggested above. Producers in some cases actually may find it advantageous to produce and brand an egg approximating the present grade B if some label other than grade B could be attached.

The results of this study indicated that a large number of consumers would not discriminate against the interior attributes of the grade B display egg. The A-B attribute differences were not critical to the remaining 53 percent of the sample population represented by those consumer groups not commenting on albumen thickness. No significant differences between the mean rating scores of grade A and B display eggs were found but the pattern of the rating scores appeared to be logical and were consistently repeated in successive surveys. An indication of the range of attribute variations acceptable to these groups, however, is provided by the fact that significant differences did exist for the B and

C mean ratings. Attribute variations as great as those existing between the A and C display eggs were distinguishable and were not acceptable to these consumers.

If a private label approximating a grade B could be produced and sold at lower cost than another grade with higher attribute standards, then the poultry industry would benefit. A private label (or a non-descript label) approximating the present grade B could be produced with considerably less fixed investment in production and handling equipment than now required for the "Fancy Fresh" label. If the consumer groupings and ratings of this study are valid, then the non-descript private label suggested above could be marketed advantageously to consumers who do not use albumen thickness as a judgment criteria.

The major difficulty with attempting to merchandise a private brand with standardization norms other than those of grade A would be the grade label requirements of the present U.S.D.A. standards. Some non-descript or non-leading label other than B or C would be a prerequisite since B or C automatically implies to consumers an inferior product. The ratings of 53 percent of the St. Louis sample of consumers indicated albumen thickness approximating that of the grade B display egg was acceptable and actually preferred by those aware of the chalaza.

The fact that different consumers evaluate a product by using different attributes suggests that one grade or norm may be based upon one attribute and another grade or norm may be based upon another attribute with each overlapping the other. There are no *a priori* grounds for supposing that one grade must be mutually exclusive unless one criteria, or two substitute criteria are used as the basis for standardization. This study suggests strongly that people do not judge by a single attribute or by a combination of all attributes; different sets of attributes are used as criteria for judging eggs.

LITERATURE CITED

1. Baker, R. L., and A. S. Goldman, "Habits, Preferences and Demands of Des Moines Egg Consumers", *Poultry Science*, 30:329-339, No. 3, 1951.
2. Banks, Quentin D., and Leonard A. Voss, *Consumer Preferences and Their Application to Egg Grading Standards and Marketing Procedures*, Missouri Research Bulletin 813, 1962.
3. Banks, Seymour, "The Relationship Between Preference and Purchase of Brands", *Journal of Marketing*, 15:145-157, No. 2, 1950-1951.
4. Bayton, James A., and Hugh P. Bell, *Preference for Canned Orange Juices That Vary in Brix-acid Ratio*, United States Department of Agriculture, Marketing Research Report 76, 1954.
5. Bayton, James A., *Perspective on Motivation Research*, National Analysts, Inc., Technical Series 4, 1955.
6. Bender, Lloyd D., and Leonard A. Voss, *A Comparison of Single—and Multiple—Stimulus Techniques of Determining Visual Preference for Eggs*, Missouri Research Bulletin 718, 1959.
- 6B. Brant, A. W., A. W. Otte, & K. H. Norris, "Recommended Standards for Scoring & Measuring Opened Egg Quality," *Food Technology*. Vol. 5, 1951, pp. 356-361.

7. Brant, A. W., and H. L. Shrader, *How to Measure Egg I. Q.*, United States Department of Agriculture, Washington, 1952.
8. Brown, George, "Measuring Consumer Attitudes Toward Problems", *Journal of Marketing*, 14:691-698, No. 5, 1947.
9. Corbett, R. B., *A Study of Consumer Preferences and Practices in Buying and Using Eggs*, Rhode Island Bulletin 240, 1933.
10. Creed, C. Richard, and Jules V. Powell, *Consumer Purchases and Uses of Eggs in Honolulu*, Bulletin 4, Department of Agricultural Economics, University of Hawaii, 1952.
11. "Equipment and Methods for Measuring Egg Quality," United States Department of Agriculture, Agricultural Marketing Service, Poultry Division, AMS, No. 246, Revised June 1960.
12. Goldman, A. S., and R. L. Baker, "Determining Consumer Preferences by Photographs", *Journal of Farm Economics*, 35:286-291, No. 2, 1953.
13. Dawson, Elsie H., Cora Miller, and Ruth A. Redstrom, *Cooking Quality and Flavor of Eggs as Related to Canded Quality, Storage Conditions, and Other Factors*, United States Department of Agriculture, Information Bulletin 164, 1956.
14. Jasper, W. A., and Raymond E. Cray, *Consumer Preferences Practices, and Demands in Purchasing Eggs and Poultry in Columbus, Ohio*, 1950, Ohio State Research Bulletin 736, 1953.
15. Kohls, R. L., and Norman Oppenheimer, *Quality Recognition and Purchasing Habits of Egg Consumers*, Purdue Bulletin 592, 1953.
16. Moore, Erman N., *Purchasing Practices and Quality Recognition for Eggs*, Bulletin 947, Department of Agricultural Economics, Cornell University, 1954.
17. Owens, A. L., and F. R. Taylor, "Consumer Knowledge of Quality Determining Factors in Eggs", *Journal of Farm Economics*, 37:625-637, No. 4, 1955.
18. Oxenfeldt, Alfred R., "Consumer Knowledge: Its Measurement and Extent", *Review of Economics and Statistics*, 32:300-314, No. 4, 1950.
19. Pennington, M. E., "Flavor and Eating Quality", *U. S. Poultry and Egg Magazine*, 38:28-31, No. 9, 1932.
20. Pond, T. H., and Lester Kilpatrick, *Grading and Inspection of Eggs and Egg Products*, United States Department of Agriculture, Information Bulletin 159, 1956.
21. "Regulations Governing the Grading and Inspection of Shell Eggs and United States Standards, Grades and Weight Classes for Shell Eggs", *Federal Register*, February 1, 4, December 23, 29, 1955, and July 13, 1956.
22. Rhodes, V. James, and E. R. Kiehl, "On Consumer Grades for Foods", *Journal of Farm Economics*, 38:44-61, No. 1, 1956.
23. Rhodes, V. James, "The Measurement of Consumer Preferences", *Journal of Farm Economics*, 37:638-651, No. 4, 1955.
24. Rhodes, V. James and others, *Consumer Preferences and Beef Grades, Theoretical Basis and Empirical Study, Development and Testing of a Model*, Missouri Research Bulletin 612, 1956.
25. Slocum, R. R., and others, "A Study of Egg Flavor in Stored Oil-treated Eggs", *U. S. Poultry and Egg Magazine*, 39:14-17, No. 4, 1933.
26. Slocum, Walter L., and Howard S. Swanson, *Egg Consumption Habits, Purchasing Patterns, and Preferences of Seattle Consumers*, Washington Bulletin 556, 1954.
27. Stadelman, W. J., and others, "Egg Preferences of Spokane Consumers", *Poultry Science*, 36:596-601, No. 3, 1957.
28. Taylor, F. R., A. L. Owens, and A. W. Jasper, *Consumer Egg Buying, Consumption and Preference Patterns*, Rhode Island Bulletin 321, 1951.
29. Taylor, F. R., *Consumer Egg Quality, Size, and Price Relationship*, Rhode Island Bulletin 322, 1955.

30. Thomsen, F. L., and Berley Winton, *Consumer Preferences for Egg Yolk Color and Shell Color in New York City*, Missouri Bulletin 329, 1933.
31. Waugh, Frederick V. (ed.), *Readings on Agricultural Marketing*, American Farm Economics Association, Ames: Iowa State College Press, 1954.

APPENDIX

TABLE 8 - MEAN RATINGS AND DIFFERENCES BETWEEN MEANS OF EXCLUSIVE CONSUMER COMMENT GROUPS WITHIN GRADES A, B, AND C, MARSHALL AND WINDSOR

Grade	Comment Group	Mean Rating	Comment Group			
			Albumen Thickness	Yolk Shape	No Comment	Chalaza
A	Albumen and Yolk	8.00	0	0.38	0.13	2.30**
	Albumen Thickness	8.00	--	0.38	0.13	2.30**
	Yolk Shape	8.38	--	--	0.51	2.68**
	No Comment	7.87	--	--	--	2.17*
	Chalaza	5.70	--	--	--	--
B	Albumen and Yolk	6.27	0.27	1.25*	1.46**	0.38
	Albumen Thickness	6.54	--	0.98	1.19*	0.11
	Yolk Shape	7.52	--	--	0.13	0.21
	No Comment	7.73	--	--	--	1.08
	Chalaza	6.65	--	--	--	--
C	Albumen and Yolk	2.43	0.78	1.05	3.17**	1.83**
	Albumen Thickness	3.21	--	0.27	2.39*	1.05
	Yolk Shape	3.48	--	--	2.12	0.78
	No Comment	5.60	--	--	--	1.34
	Chalaza	4.26	--	--	--	--

* Significance at the 5 percent level and ** at the 1 percent level determined by pooled variance.

TABLE 9 - DIFFERENCES BETWEEN GRADE MEAN RATINGS BY EXCLUSIVE CONSUMER COMMENT GROUPS, MARSHALL AND WINDSOR

Between Grades	Comment Group				
	Albumen and Yolk	Albumen Thickness	Yolk Shape	No Comment	Chalaza
B and A	1.73**	1.46**	0.86*	0.14	0.95
C and B	3.84**	3.33**	4.04**	2.13	2.39**
C and A	5.57**	4.79**	4.90**	2.27*	1.44

* Significance at the 5 percent level and ** at the 1 percent level determined by pooled variance.

TABLE 10 - MEAN RATINGS AND DIFFERENCES BETWEEN MEANS FOR GRADES A, B, AND C EGGS BY CONSUMER COMMENT GROUP, MARSHALL - WINDSOR AND ST. LOUIS

Grade	Sample	Comment Group				
		Albumen and Yolk	Albumen Thickness	Yolk Shape	No Comment	Chalaza
A	Marshall - Windsor	8.00	8.00	8.38	7.87	5.70
	St. Louis	7.11	7.45	7.47	7.28	6.17
		.89**	.55	.91	.59	-.47
B	Marshall - Windsor	6.27	6.54	7.52	7.73	6.65
	St. Louis	5.06	5.92	6.85	6.94	6.63
		1.21**	.62	.67	.79	.02
C	Marshall - Windsor	2.43	3.21	3.48	5.60	4.26
	St. Louis	2.83	3.25	3.74	5.75	4.35
		-.40	-.04	-.26	-.15	-.09

* Significance at 5 percent level and ** 1 percent level determined by pooled variance.