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USE OF THREE-DIMENSIONAL COLOR PICTURES IN
CONSUMER PREFERENCE STUDIES OF BEEF*

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Prior to 1953, co-operative studies involving the agricultural experiment stations of several of the western states as well as the Agricultural Marketing Service of the United States Department of Agriculture had helped to define the characteristics of the marketing flow of livestock from producer through processor and retailer to consumer in the states of the west. One report of such studies, by Vrooman and Abel⁽¹⁾, showed the proportions of the different grades of beef slaughtered during the period from July 1, 1951, through June 30, 1952, in three western regions to be as follows:

In the mountain states composed of Wyoming, Colorado, New Mexico, and Utah, almost 75 per cent of the beef graded prime, choice or good. In the region composed of California, Arizona, and Nevada, 61 per cent of the beef was in those categories. In the Pacific Northwest States of Oregon, Washington and Idaho, only 44 per cent of the beef slaughtered graded prime, choice, or good.

Such information as this raises the question of whether or not the quality of beef supplied to each of the three regions or to each of the separate states is meeting the desires or preferences of the consumers. It would be difficult to believe that the people of Oregon, for instance, prefer the lower grades of meat, whereas the people of Colorado prefer the higher grades to the extent that the figures above indicate. It is more likely to be true that the people in these two states, as well as in other states, consume the kind of meat that they do because that is the kind supplied to them or the kind that fits their economic status, and that there is not necessarily a relationship between consumption and preference. With very little effort, one can be misled by consumption data which is interpreted to show preferences, especially when the consumer is not presented with a multiple of possible choices which include the item of greatest preference.

Although producers of meat animals and processors of meat are constantly trying to meet the quality demands of the consumer and to devise new products to increase the consumption of meat, they cannot clearly define their goals, nor design the methods for reaching those goals, without a clear picture of what the consumer desires. Also, the more nearly producers or processors meet the desires of the consumer, the greater will be the demand for the product and probably the monetary return to them.

Determination of preference for consumer goods is extremely difficult because there are so many variable factors involved. In designing consumer preference studies, none of these variables can be overlooked or uncontrolled

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if completely valid results are to be secured. Fresh meat is a particularly difficult commodity to study because of the strong influences which are exerted by availability, advertising, promotion, and merchandizing of the meat, and by the knowledge, experiences, habits, prejudices and financial status of the consumer. However, if we at once set as our goal the determination of what the consumer wants rather than what the person accepts, the problem is at least brought into sharper focus and there is a strong guiding principle to follow in designing the studies to make the determination.

The agricultural experiment stations of Arizona, Colorado, Oregon, Texas, Washington, and Wyoming are co-operating in trying to determine just what kind or quality of fresh beef the consumers in the west want. In this Western Beef Preference Project, two general approaches to the problem are being used.

They are: 1. A household survey which will attempt to determine by questionnaire what people say they prefer. 2. Controlled experiments in retail stores to determine what people actually do when confronted with a number of specific purchasing situations.

In this paper, a third approach is described which appears to offer certain advantages and improvements over the other two, and this will be used in the future at least in Oregon.

Some of the household surveys have been completed in Arizona and have been reported by Seltzer⁽²⁾. Because of the complexity of the studies and the limitations placed on this paper, it is suggested that the publication be reviewed by those who are interested in this subject.

The research by Oregon State College has been confined thus far largely to the development of a technique which will eliminate some of the problems encountered in the other approaches. This technique involves the use of three-dimensional color pictures of beef in lieu of fresh beef samples in determining consumer preferences. It also involves the objective definition of the quality of the samples viewed by the consumers.

Cuts of fresh meat deteriorate rapidly when not protected against evaporation, heat, oxidation, and microorganisms. There is an extreme limitation on the length of time that a piece of fresh meat "remains the same." Where the opinions of a large number of consumers are sought to obtain data which will yield statistically sound conclusions, it is highly desirable that all consumers should view the same or very similar samples. The length of time that fresh cuts of meat can be used as samples becomes a serious problem in experimental design, and even the "renewing" of samples with similar cuts taken from the same carcass is not satisfactory because of variability from cut to cut.

Colored photographic prints of meat lack realism even to the person who is inexperienced in judging meats. However, superior pictures can be secured with the three-dimensional techniques if reasonable care is exercised in taking the pictures and in presenting them for viewing. Although there are degrees of perfection in duplicating the realism of subjects in these studies, it was felt that no unusual equipment or unreasonable procedure should be used unless necessary because of the limitations they would place on the broad application of the method.

Experimental Procedure:

A Stereo-Realist 35 mm camera was employed in photographing the meat samples. The source of illumination was four General Electric #1 photoflood bulbs in Smith-Victor 10" reflectors. The power was controlled by an electrical circuit consisting of a 115 volt transformer, a voltage regulator, and a voltmeter. This power train is essential for maintaining constant light intensity on the samples.

A frame approximately 40 x 40 x 40 inches, made of 3/4" pipe, supported the camera and flood-lamps at prescribed distances. The camera was mounted at the top of the frame and was pointed downward toward the meat which lay in a horizontal plane on a plywood platform. The platform was adjustable to variable focusing distances demanded by the different sizes of the cuts of meat.

Black rayon velour paper (Carter Rice Paper Company, Portland, Oregon) was used as background for the meat to eliminate light reflection and shadows as well as enhance the natural color and appearance of the meat samples.

Kodachrome film, type K335-A of identical emulsion number, was used throughout. It was held at about 35° F. prior to use to minimize film variables. The exposed film was processed and the pictures mounted in the usual paper frames by a commercial laboratory with special care. TDC stereo-viewers were used in showing the colored slides to consumers.

Recognizing the possibility of using three-dimensional color pictures in lieu of the fresh cuts did not permit their use without validation. Therefore, certain experiments were designed specifically to demonstrate whether or not people would give the same response to the pictures as to the fresh cuts.

With the invaluable counsel of L. D. Calvin, Station Statistician, the following experiments were designed:

- Part 1. In this experiment, two cuts of beef (rib roasts and round steaks) were taken from beef carcasses graded prime, choice, good, commercial, and utility, photographed, and then displayed in a Corvallis retail dealer's meat display case. During one weekend, the meat customers in the store were asked to select their preference from the fresh samples; the following weekend as many as possible of the same people were shown pictures of exactly the same samples they viewed the week before and again asked to give their preference. The samples were selected and arranged to avoid bias of position, etc. and three samples were presented for one judgment. The cuts were presented in arrangements which would show the degree to which people could duplicate with the picture their preference demonstrated with the fresh cuts when
- a. The three samples viewed represented three different but consecutive grades.
 - b. The three samples viewed represented the same cut from three different carcasses of the same grade.
 - c. The three samples viewed represented the successive cuts from one carcass.

The cuts of meat were replaced by fresh cuts in the display case each 3 hours. They were placed on a black paper background in the case.

- Part 2. This experiment measured the degree to which people show the the same preference among three samples when shown the same picture twice with an interval of one week in between viewings.

- Part 3. In this experiment, two cuts of beef (T-bone steak and arm roast) from choice, good, and commercial carcasses were displayed in a retail meat store and the preference between the three grades for each cut was determined with 511 meat customers. One week later, pictures of the same samples were shown to 403 meat customers, irrespective of their having seen the fresh cuts, and their preferences were recorded. Fresh samples were put in the store on the morning of each of the two days of a test (Friday and Saturday) and were not replaced during the entire day. However, positions of the samples relative to one another were changed each 3 hours and pictures were taken each 3 hours. The

pictures were used one week later in the same order and during the same relative time intervals as the fresh samples from which they were made.

In all of the above, the consumers were asked only one question: "Which one of the three pieces of meat would you prefer to buy?" There were no markings on the meat such as prices or grades. If people asked about price, they were told to make their selection on the basis of the price per pound being equal for all pieces and low enough to be well within their ability to pay.

It is intended that the three-dimensional photographic technique for determining consumer preference for beef be combined with some measurement of the quality of the beef cuts viewed. It will be noted that beef of different U.S. grades was used. This was done only to provide a range of qualities as we usually believe they exist between different animals. To aid in more completely characterizing the samples viewed, certain chemical, physical, and organoleptic determinations have been made.

Although they are too few to permit valid conclusions until additional samples are tested, the determinations on samples used in Part 1 included the following:

1. Fresh meat cuts
 - a. Trained panel scoring of the appearance and feel, including the texture, firmness, and color of the lean, the firmness and color of the external and internal fat, and the degree of marbling. Color paddles were used as an aid.
 - b. Measurements with a planimeter on the projections of the pictures to determine proportions of fat, lean, bone and gristle.
 - c. Instrumental color measurements of lean and fat (it may be possible to measure color in the photographs).
 - d. Analysis for moisture, fat, and protein of entire cuts and also appropriate portions, and determination of pH.
2. Cooked meat cuts (cooked by standardized methods appropriate to each cut).
 - a. Trained panel scoring of aroma, flavor of lean and fat, tenderness, juiciness and texture.
 - b. Instrumental measurements of tenderness and juiciness.
 - c. Cooking data including cooking loss and drip.

Results and Discussion:

Part 1. This experiment produced several things of interest, but did not completely substantiate the use of three-dimensional pictures in lieu of fresh meat samples. In the first place, the results indicated that, irrespective of whether the consumers were viewing the fresh meat samples or the pictures, they did not seem to be able to discriminate any better among samples in which the grades were different (a above) than when the grades (b above) and even carcasses (c above) were the same. In the case of round steaks, this could be explained by there being relatively small differences between steaks from different grades of animals of the same weights. However, the same situation was observed with rib steaks where differences between consecutive grades were relatively large.

A second point of interest was that the ability of the people to duplicate their selection was not much greater than would be expected by chance. Because only three selections were possible, one-third of the people could be expected to duplicate their first selection by chance alone. In these studies, one-half of the people duplicated their first selection.

As a third point, the experiment had been designed with so many variations of meat sample combinations that relatively few people viewed both fresh meat and pictures of any one combination in the allotted time of the experiment.

Finally, there was considerable question as to whether or not people could duplicate their selections if they viewed the same meat samples or the same pictures at two different times. This led to conducting Part 2 of these studies.

Part 2. It was suggested that actual meat samples be used in this experiment, but it was considered undesirable to try to use the same meat samples, even after "facing", over a period of more than about 48 hours. With this short period, people may be able to remember the specific cut they selected the first time.

Therefore, pictures of round steaks and rib roasts used in Part 1 were again used and it was found that 67% of 75 people were able to choose the same sample the second time they looked at the picture as they had the first time one week previously. Judging from the casual comments of consumers as they viewed the pictures the second time, it appeared that some people selected the same samples by memory. Also, the relatively low repeatability may be attributed to there being only small differences between the meat samples.

Although this study was conducted with pictures, there is no special reason to believe the result would be different if fresh meat samples could be used.

Part 3. When arm roasts and T-bone steaks cut from choice, good, and commercial carcasses of about the same weight were viewed in the store by 511 customers and one week later pictures of the same cuts were viewed by 403 customers, the following percentage distribution of preferences was obtained:

	Choice	Good	Commercial
Arm Roasts:			
When meat samples viewed	22%	65%	13%
When 3-D pictures viewed	11%	84%	5%
T-Bone Steaks:			
When meat samples viewed	26%	66%	8%
When 3-D pictures viewed	22%	72%	6%

Here there was no question that the people detected differences among grades. With the T-bone steaks, the meat customers' behavior was relatively the same with both fresh cuts and three-dimensional pictures. With the arm roasts, there was some evidence that the preference for the "good" samples was more pronounced with the pictures than with the fresh cuts. This was not significant at the 1% level although significant at the 5% level.

Summary:

These experiments show that when sufficiently large numbers of people are used in a consumer survey, they will probably show the same pattern of preference for fresh beef whether they are tested with fresh cuts or with three-dimensional pictures of the cuts. Since the purpose of the Western Beef Preference Project and of most meat preference studies is to determine preferences

of large groups of people, the use of three-dimensional color pictures of meat obtained and used by the above techniques appears to be acceptable and valid.

Comments:

Besides being useful for determining consumer preferences between different qualities of fresh cuts of meat, three-dimensional color pictures should also be useful in the following and other studies concerned with consumers:

1. The influence of grade or brand markings on selection of fresh meat.
2. The influence of price and price differentials on selection.
3. The influence of the removal of fat or bone.
4. The influence of style of cut.
5. The influence of size of cut.
6. The influence of packaging or package design.
7. The influence of sales aids or displays.

The permanency of the pictures would also permit such studies as:

1. Regional differences in relation to consumer preferences.
2. Uniformity of grading from one geographical area to another.

It would be expected that the use of three-dimensional color pictures would not be confined to consumer studies of meat, but could be used for other commodities as well. However, they would be particularly useful in studies with perishables.

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