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Consumer Knowledge of Selected Nutrient Content of Nine Fresh Meat Cuts

Alvin Schupp, Robert Downer, Jeffrey Gillespie, and Debra Reed

The U.S. Department of Agriculture, the Food and Drug Administration, and the medical profession, among others, have attempted to broaden consumers' knowledge of the nutritive content of foods. Retailers provide information by supplying point-of-purchase nutrition information and/or nutrition labels on fresh meats. The availability of nutrition information on packaged fresh meats is relatively new. A survey of Louisiana households provided estimates of their knowledge of the fat, cholesterol, and protein content of selected combinations of fresh beef, pork, chicken, and turkey meats. Permutation analysis and tabular analyses were used to assess households' nutrition knowledge of the selected fresh meats.

Key Words: beef, chicken, consumer knowledge, nutrient content, permutation analysis, pork, turkey

In the last decade, there has been a concerted attempt by the U.S. government, the medical profession, and the food industry to increase consumer knowledge of human nutritional needs and the nutrient content of foods. The most recent government effort to increase consumers' nutritional awareness was enactment of the Nutrition Labeling and Education Act (NLEA) by the U.S. Congress in 1990. This Act called for mandatory nutrition labeling of processed foods and the voluntary nutrition labeling of fresh meats and seafood. The NLEA could be considered a natural progression of the U.S. Department of Agriculture's (USDA's) national nutrition education program, detailed in its publication titled *Nutrition and Your Health: Dietary Guidelines for Americans.* An important component of the USDA *Guidelines* is the "Food Guide Pyramid." This "pyramid" provides recommendations on the numbers of servings from the various food groups that should be consumed daily as part of a healthy diet.

Alvin Schupp is Martin D. Woodin Professor of Agricultural Business, Department of Agricultural Economics and Agribusiness; Robert Downer is assistant professor, Department of Experimental Statistics; and Jeffrey Gillespie is assistant professor, Department of Agricultural Economics and Agribusiness—all with the Louisiana State University Agricultural Center, Baton Rouge. Debra Reed is assistant professor and nutrition specialist, Texas Agricultural Extension Service, Texas A&M University, College Station.

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Because a vast quantity of research has addressed the effect of nutrition on human health, a full review of the literature is unwarranted here. However, data indicate that consumers continue to eat too many foods that are high in fat and cholesterol, especially meats (Variyam, Blaylock, and Smallwood), despite educational efforts of the USDA, the medical profession, and others (Frazao).

How knowledgeable is the typical consumer about the nutrient content of specific foods, given current nutrition labeling information? To address this question, accurate data are needed for estimating the effectiveness of current educational programs in developing consumer awareness of (*a*) the nutrient content of foods, and (*b*) how various foods can be used to meet daily nutrient requirements.

Prior to enactment of the NLEA, only limited nutritional information was available on packaged processed foods. Food manufacturers now estimate the nutrient content of processed foods by nutrient testing before packaging and labeling, thus providing accurate nutrient data for labels. But fresh meats present a more difficult challenge in the estimation of nutrient content. Cuts of fresh meat have been highly variable in their content of fat and somewhat less variable in cholesterol and total calories by cut, geographical area, and over time. However, recent changes in management programs for live animals, combined with the use of standardized cuts and operational procedures at the processor and retail levels, have resulted in increased uniformity of meat cuts (Frazao). The nutrient content of a serving of fresh beef, pork, turkey, or chicken can now be specified with reasonable accuracy across stores and geographic areas. Given these changes and NLEA requirements, consumer knowledge of the nutrient content of specific meat cuts should be increasing.

Based on our review of current literature, we believe this research represents only the second attempt to assess the nutrient knowledge of specific fresh meat cuts among U.S. households. In their 1997 study, Smith, Johnson, and Wang investigated consumer knowledge of the fat content in pork spare ribs/loin chops, regular hamburger/ground round, and porterhouse steak/round steak, in addition to the cholesterol content in liver/T-bone steak. Our study differs in that we include the nine most popular cuts of beef, pork, chicken, and turkey; we use three groups of three cuts each (instead of two cuts per group), with each group differing less in nutrient content among cuts; and we add protein to the nutrient comparisons.[1]

The objective of this study was to estimate whether consumers could identify specific fresh cuts of beef, pork, chicken, and turkey having the highest quantities of total fat, cholesterol, or protein. The following hypothesis was tested: Respondents can more accurately identify meat cuts highest in total fat than in cholesterol or protein.

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[1] The term "cut" is used throughout this article to represent a specific fresh meat product. The authors recognize that ground meat (beef or pork) is not a meat cut; however, for ease of our discussion of meat products here, this term is preferred over the use of more complex technical terminology.

Data and Methods

A questionnaire was designed to elicit consumer knowledge and perceptions of the nutrient content of selected fresh meats. Drafts of the survey instrument were reviewed by students in a nutrition class and by members of a consumer focus group at Louisiana State University. Following a modified Dillman mail procedure, the survey was sent to 3,180 randomly selected households in Louisiana in 1997.

In designing the survey, we did not expect that representative consumers would be knowledgeable of the absolute quantities of total fat, cholesterol, or protein in three-ounce servings of fresh meat cuts. Consequently, we chose to examine consumers' ability to identify, from a choice of three fresh meat cuts, the one cut with the highest content of total fat, cholesterol, or protein.

Three groups of fresh meat cuts were included in this study, with each group containing three different cuts. The selection of cuts and subsequent groupings were determined by a nutrition specialist, and consisted of nine cuts of fresh beef, pork, chicken, and turkey: Group 1, which included regular ground beef, center cut pork chop, and boneless/skinless chicken breast; Group 2, comprised of ground pork, beef rump roast, and turkey drumstick with skin; and Group 3, containing beef ribeye, chicken leg quarter with skin, and turkey breast with skin. Respondents were told to assume equal sized servings of each cut and that the external fat trims used by the major supermarket chains (one-eighth inch) were applied to all intact cuts of beef and pork. The survey participants were initially asked to identify which of the three cuts in each group had the highest content of total fat, and then were instructed to repeat this evaluation process for both cholesterol and protein.

Table 1 reports the actual quantities of total fat, cholesterol, and protein in three ounces of each of the nine cuts, as well as the respondent ranking percentages. Regular ground beef, ground pork, and beef ribeye are highest in actual total fat content in their respective groups. Similarly, products highest in cholesterol are regular ground beef, ground pork, and chicken leg quarter with skin. Cuts that are highest in protein, by respective meat groups, are boneless/skinless chicken breast, beef rump roast, and turkey breast with skin.

A permutation test (Good) was used to determine whether consumers have knowledge of nutrient content among meats by species. A null hypothesis of no prior knowledge regarding the nutrient content of the meats was tested versus an alternative hypothesis that a higher proportion of the respondents actually know which of the three choices in each group is highest in nutrient content.

The hypothesis H_0: $p_1 = p_2 = p_3$ (where p_i is the unknown proportion in the population which believes that choice j has the highest content for the specific nutrient) was tested versus H_a: $p_1 > p_2$, $p_1 > p_3$ (where choice 1 actually contains the most of the given nutrient). For example, in Group 1 for total fat, the null hypothesis H_0: $p_{beef} = p_{pork} = p_{chicken}$ was tested versus H_a: $p_{beef} > p_{pork}$, $p_{beef} > p_{chicken}$, since beef is highest in fat content in that group. The respondents' vector of responses for each group-nutrient combination was treated as an independent multinomial to test each hypothesis. Ten thousand case vectors from a multinomial distribution, with index

Table 1. Actual Fat, Cholesterol, and Protein Content in Nine of the Most Popular Fresh Meat Cuts, and Percentages of Louisiana Respondents Rating These Same Cuts Highest in Fat, Cholesterol, and Protein (1997)

	FAT		CHOLESTEROL		PROTEIN	
Meat Group and Cut	Actual Nutr. Total (gms)	Percent Respondents Choosing Cut	Actual Nutr. Total (mgs)	Percent Respondents Choosing Cut	Actual Nutr. Total (gms)	Percent Respondents Choosing Cut
GROUP #1:						
Regular ground beef	26.5	84.4	85	55.6	16.6	33.8
Center cut pork chop	12.6	14.1	62	39.8	19.7	12.5
Boneless/skinless chkn breast	9.3	1.5	64	4.6	20.9	53.7
GROUP #2:						
Ground pork	21.2	58.5	72	48.8	16.9	11.6
Beef rump roast	15.9	22.7	64	25.6	19.9	60.6
Turkey drumstick w/skin	6.7	18.8	71	25.6	19.5	27.8
GROUP #3:						
Beef ribeye	22.1	46.5	68	49.5	17.5	52.1
Chicken leg quarter w/skin	12.1	48.6	83	35.1	18.1	12.7
Turkey breast w/skin	7.0	4.9	65	15.4	21.9	35.2

Note: Actual fat, cholesterol, and protein nutrient values in 85-gram (three-ounce) samples were obtained from *Perspectives in Nutrition* (Wardlaw and Insel, 1996).

equal to the number of observed respondents and equal cell probabilities (i.e., under H_0), were generated and the probability of each was recorded.

Within a given group, a test of the pairwise equality of the population proportions which would correctly identify the cut of highest content was conducted. In the test of H_0: $p_{fat} = p_{chol}$ versus H_a: $p_{fat} \neq p_{chol}$, the estimated proportions $\hat{p}_{fat}$ and $\hat{p}_{chol}$ are the fractions of respondents correctly choosing the cut with the most fat and cholesterol, respectively, for that given group. The test was conducted for all three groups of cuts—first for fat versus cholesterol, then for fat versus protein.

Results

Of the 3,180 surveys mailed to randomly selected Louisiana households, 622 were completed and returned, yielding a response rate of 20%. This is a reasonable response rate, based on those reported for similar consumer surveys (e.g., Piedra, Schupp, and Montgomery; Nayga; Jensen et al.). A number of factors explain the large proportion of nonrespondents (refusals)—i.e., the survey was unsolicited, the survey may have been considered somewhat intimidating by some household members, and some prospective respondents may have questioned the relevance of the study.

The percentages of respondents rating each product highest in the three nutrients by group are given in table 1. With three exceptions, the greatest percentage of respondents correctly picked the cut with the highest actual quantity of nutrient in each of the three groups. The exceptions occurred in Group 3 for total fat, cholesterol, and protein. Whereas the actual quantities of total fat in Group 3 meat cuts were highest for beef ribeye (22.1 gms), followed by chicken leg quarter with skin (12.1 gms), and turkey breast with skin (7 gms), chicken leg quarter with skin was identified by 48.6% of the respondents as having the highest fat content, followed by beef ribeye (46.5% of respondents), and turkey breast with skin (4.9%). Likewise, a large number of respondents (49.5%) chose beef ribeye as highest in cholesterol, while chicken leg quarter with skin was the correct choice (at 83 mgs cholesterol versus 68 mgs for beef ribeye). More respondents (52.1%) also chose beef ribeye as highest in protein, when it actually contained the least protein in the group (17.5 gms as compared to the correct choice of turkey breast with skin at 21.9 gms).

In percentage terms, respondents accurately rated the three cuts of fresh meat in Groups 1 and 2 for total fat (table 1); the order of the actual quantities of total fat coincided with the order of respondent percentages. For protein, however, these orderings were accurate only in Group 2, and were inaccurate in all three groups for cholesterol. There are at least two likely explanations for these results. First, due to the assignment of cuts to groups according to total fat content, the quantity of total fat differed greatly across the cuts in the three groups, while the quantities of cholesterol and protein differed less. Second, the consumer can actually see the quantity of fat in fresh meat cuts, but the quantities of cholesterol and protein are visually unobservable. For these reasons, consumers should possess a higher level of capability in estimating the total fat content of these fresh meat cuts, even in the absence of label or point-of-sale nutrition material.

For the permutation test (H_0: $p_1 = p_2 = p_3$ versus H_a: $p_1 > p_2$, $p_1 > p_3$), the observed data of six of the nine group simulations fell within the defined rejection region (the sample proportion of highest nutrient content category greater than each of the others). To derive the test's *p*-value, the probability of obtaining the observed data (e.g., for Group 1 total fat, 389, 65, and 7 respondents, respectively, for beef, pork, and chicken) was ranked among the probabilities of obtaining other simulated case vectors from the 10,000 which also fell within the rejection region under H_0. A *p*-value of less than 0.0005 was observed in each of six group-nutrient categories: Groups 1 and 2 for total fat, cholesterol, and protein.

With statistical inference, it is possible to declare a significant result even when H_0 is true, resulting in a type I error. This probability increases with multiple tests. However, even with a conservative Bonferroni multiple-testing correction, each of these results is significant. In all six situations, there is strong evidence against the null hypothesis of random choice selection, or that the respondent population has no knowledge of nutrient contents. The observed data for these six group-nutrient combinations suggest that a higher proportion of the respondent population correctly selected the cut with the highest nutrient content.

Table 2. Accuracy of Knowledge of Fat, Cholesterol, and Protein Content in Meat Cuts: Results of Tests of Difference Among Proportions, *Z*-Distribution

	Fat versus	
Meat Group	Cholesterol	Protein
GROUP #1	9.346*	9.847*
GROUP #2	2.863*	0.707
GROUP #3	3.364*	2.088**

* Significant at the 5% level with Bonferroni multiple-testing correction.
** Significant at the 5% level, but not with Bonferroni multiple-testing correction.

To investigate specific differences among the nutrients, the hypotheses H_0: $p_{fat} = p_{chol}$ versus H_a: $p_{fat} \neq p_{chol}$, and H_0: $p_{fat} = p_{protein}$ versus H_a: $p_{fat} \neq p_{protein}$ were tested. Results of the *Z*-test (Zar) indicate that, at the 5% level, there was greater knowledge of total fat than of cholesterol content for all three groups of cuts, and greater knowledge of total fat than of protein for meat Groups 1 and 2. With the exception of Group 2/fat versus protein, all of these significant relationships would remain under a Bonferroni multiple-testing correction (see table 2). Hence, as expected for these cuts, respondents were more knowledgeable of total fat content than of cholesterol and protein.

Discussion

Given that information on the nutrient content of fresh meat cuts had not been provided in retail food stores prior to 1994, nutrient knowledge among consumers was not expected to be high. This research was designed to estimate the ability of typical Louisiana consumers to identify fresh meat cuts with a high specific nutrient content (fat, cholesterol, or protein).

Respondents had much less difficulty in making a distinction between fresh meat cuts when rating total fat content. Since our results suggest that the population represented by the respondents is generally knowledgeable enough to select the meat cut with the highest fat content, educational efforts may be succeeding in this regard. A combination of visual observation and emphasis by numerous nutritional agencies on the need to curtail fat consumption has tended to heighten consumer awareness of fat, especially in red meats. In contrast, respondents' ability to choose among meat cuts highest in cholesterol and protein was significantly lower, reflecting (among other things) the absence of visual physical distinctions in the product itself and the much smaller absolute differences in cholesterol and protein content among cuts in the three meat groups.

The smaller the nutrient variability among meat cuts, the less incentive the consumer has to be knowledgeable of the differences that exist among meat cuts in that

nutrient. As seen in table 1, variability in cholesterol and protein content among the nine cuts is low. Therefore, any of these cuts can be consumed without greatly altering intake of these nutrients. Consumers may be acting rationally in placing greater emphasis on distinguishing total fat differences among cuts.

Not surprisingly, respondents' abilities to choose the meat cut with the highest nutrient level were dependent upon the group of meats presented. In Groups 1 and 2, there is strong evidence of consumer knowledge of the fresh cut with the highest nutrient content; in Group 3, there is less evidence to suggest this knowledge (table 1). In Groups 1 and 2, ground meat products with the highest levels of fat and cholesterol and the lowest levels of protein are present. Perhaps consumers are less able to distinguish nutrient content differences in intact muscle cuts, but perceive ground meats as being inferior with higher levels of fat and cholesterol and lower protein. Furthermore, respondents could have more difficulty in assessing the nutrient content of poultry products than red meat products, and hence were more successful when each group contained mostly red meat cuts (Groups 1 and 2) and were less successful when the group contained mostly white meats (Group 3). These are areas for future research.

It is encouraging that the consumer respondents who participated in this study demonstrated an appreciable level of knowledge of the nutrient content of fresh meat cuts given that point-of-purchase nutrition information and/or labels on fresh meats have been available for only a limited period. However, with little evidence to suggest that consumers are able to adequately distinguish nutrient contents among intact muscles with widely varying total fat content, it appears that more time is needed for these labeling and educational programs to significantly improve consumers' knowledge of specific nutrients in fresh meat cuts.

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