CONSUMER RATINGS OF RESTRUCTURED BEEF STEAKS MANUFACTURED TO CONTAIN DIFFERENT RESIDUAL CONTENTS OF CONNECTIVE TISSUE

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ABSTRACT

Restructured beef steaks were evaluated by consumers (n=90 households) in Houston, TX. Consumers were selected to assure that demographic representation -- age, ethnic background, income, education, etc. -- was accomplished. Restructured beef steaks were manufactured from 27 beef shoulder clods (nine per treatment) that were subjected to different degrees of connective tissue removal -- no trim (NT), intermediate trim (IT) and extensive trim (ET). Consumers rated ET steaks highest, IT steaks intermediate and NT steaks lowest for overall desirability with significant differences found among the treatments. Consumers perceived this product as being intermediate in monetary value when compared to ground beef and T-bone steak.

INTRODUCTION

Restructured meat products have yet to achieve the acceptance and/or retail market share that was once predicted for them. The poultry and seafood industries have taken advantage of restructuring technology and have made significant gains in marketshare at retail and food service levels such that per capita consumption of poultry is expected to equal or surpass beef consumption by 1990 (Anonymous, 1986). These industries have promoted portion control, standardized fat content and convenience of their products, all of which are traits that consumers have become increasingly aware of and, to an extent, even demand.

Consumers, due to price, diet-health concerns and/or personal preference, are demanding leaner beef products (Savell et al., 1986). Restructuring will make possible beef that is lean, tender, juicy, flavorful and, most importantly, reasonably priced. However, one

possible drawback in manufacturing restructured beef steaks to have texture similar to that of intact muscle is that larger pieces of meat must be used to achieve this steak-like texture. The use of larger meat pieces creates the potential for problems with connective tissue residue (sensorily perceptible) in restructured beef steaks because lower-valued cuts of meat, often those higher in connective tissue, are utilized in the production of these steaks. Some researchers (Breidenstein, 1982; Secrist, 1982) consider connective tissue residue as a major obstacle to overcome before consumers will accept restructured beef steaks. Unfortunately, very limited research on the consumer acceptance of restructured beef steaks has been conducted to substantiate this belief.

Berry et al. (1984) found that restructured beef steaks made to contain extra high levels of connective tissue were more acceptable to consumers than steaks manufactured to contain low levels of connective tissue. This finding contradicts the response that would be anticipated regarding residual connective tissue in restructured beef steaks. However, Berry et al. (1986) stated that texture profile panelists found a greater amount of gristle in restructured meats made from raw material with high connective tissue.

Recent findings by Recio et al. (1986) indicate that trained panelists can detect palatability differences between steaks from beef clods trimmed of all visible surface connective tissue and those steaks made from clods with no trimming of any connective tissue that was attached, around or within the muscle or muscle group. They concluded that based on trained sensory panel data, removing some, but not all of the heavy connective tissue from beef clods would be worthwhile. Because limited research has been conducted on consumer acceptance of restructured beef steaks, this study was conducted to determine the acceptability of restructured beef steaks manufactured to contain different residual contents of connective tissue.

MATERIALS AND METHODS

Manufacturing

Restructured beef steaks were manufactured from beef shoulder clods to contain one of three levels of connective tissue as outlined by Recio et al. (1986). Treatments were no trim (NT), intermediate trim (IT), and extensive trim (ET), which represented the amount of connective tissue -- ligaments, epimysium, and periosteum -- removed from the clods.

Following treatment application, each separated lean and fat fraction was placed in polyethylene bags, removing as much air as possible, and crust-frozen at -30°C for 1 hr. Both fractions were taken out of their bags for further processing. The lean fraction was coarsely ground through a grinder equipped ;with a 3-hole, "kidney-shaped," plate and conventional knife with four full-length arms. The fat fraction was flake-cut using a Comitrol® (model 3600 Urschel Laboratories, Inc., Valparaiso, IN) equipped with head size 2-K-020060. The fractions were then formulated into meat blocks containing 15% fat. Each meat block was placed in a Butcher Boy mixer (model 150, Lasar Manufacturing Co., Inc., Los Angeles, CA) and 0.5% sodium chloride along with 0.125% sodium tripolyphosphate was added. Batches were then mixed for 10 min, stuffed into bags (Cryovac® 18 X 70 cm "keeper casing;" Cryovac Inc., Duncan, SC) crust-frozen for 3 hr at -30°C and tempered at -4°C for 1 hr. The logs were unwrapped and pressed into the shape of a loaf using a Ross hydraulic press (model 914 Ross Industries, Midland, VA). Each log was then sliced into 2.0 cm steaks using a Ross slicer (model 950-2). The steaks were then vacuum packaged using a high oxygen-barrier, skin-type package and subsequently frozen at -30°C.

Consumer Research Design

The consumer research was conducted in Houston, TX in cooperation with the Texas Agricultural Market Research and Development Center, The Texas A&M University System, and a private firm with expertise in market research. The households that participated in this study were selected to assure that demographic representation -- age, ethnic background,

and income -- was accomplished. Sampling was conducted within the same guidelines used by Branson et al. (1984) and was restricted to households within Harris County, Texas; recruitment was by telephone and households were screened to eliminate non-beef eaters.

Each sample household received three restructured beef steaks, one steak per week, over a three-week period. A steak from each treatment -- no trim, intermediate trim or extensive trim -- was delivered to each household in a randomized order.

Demographic Parameters

Three demographic measures -- age, education and income -- were used to characterize the panelists in this study. Panelists were asked to characterize their age in one of the following categories: 29 years and younger, 30-49 years or 50 years and older. Three levels of education were used to categorize the panelists: grammar and/or high school, technical school or college. Four levels of yearly income were used to segment the panelists: less than $15,000, $15,000 - $24,999, $25,000 - $49,999 or $50,000 and over.

Household Restructured Beef Cooking Methods

Household panelists were asked to prepare ;the steaks and to characterize their choice of cookery by using one of the five categories for cooking methods: broiling in the home, broiling outside the home, oven broiling, pan frying or other.

Panelists were also asked to record the degree of doneness to which each steak was prepared using the following scale: 1=very rare (inside color mostly red), 2=rare (inside color very pink), 3=medium rare (inside color considerably pink), 4=medium (inside color moderately pink), 5=well done (inside color only slightly pink) or 6=very well done (inside completely gray). It was suggested to the panelists that steaks be cooked to a "medium" degree of doneness to allow for improved binding of meat pieces, however, not all panelists complied.

Palatability Evaluations

Juiciness, juiciness desirability, tenderness, tenderness desirability, flavor desirability,

desirability of "gristle" present, and overall desirability were evaluated by the panelists with scores assigned by use of the following scales: juiciness, (9=extremely juicy, 1=extremely dry); tenderness (9=extremely tender, 1= extremely tough); and juiciness desirability, tenderness desirability, flavor desirability, desirability of "gristle" present and overall desirability (9=extremely desirable, 1=extremely undesirable).

Size and Thickness Ratings and Preference

Panelists also responded with regard to their perceptions of the relative size and thickness of the steak using the following scales: thickness (9=too thick, 5=preferred thickness, 1=too thin); size (9=too large, 5=preferred size, 1=too small). In addition, consumers responded as to the parameters of weight and thickness (1=6.4 mm, 2=9.5 mm, 3=12.7 mm, and 4=19.1 mm) that would be preferable to them in deciding whether or not to purchase and consume products of this kind.

Likely Use and Frequency of Use

Panelists were asked to indicate anticipated uses and frequency of use per month they would make of such steaks if these steaks were available at the retail counter (in place of regular steak; in place of ground beef/hamburger; in place of sandwich meats; and in place of chicken).

Purchase Intentions

Panelists responded as to the price they would be willing to pay for this product if T-bone steaks were $9.90/kg and lean ground beef was $3.30/kg.

Statistical Analysis

Data were analyzed by analysis of variance using the General Linear Model program of the Statistical Analysis System (SAS, 1982). Means were separated using Duncan's multiple range test (Duncan, 1955).

RESULTS

With respect to demographics (not presented in tabular form), a relatively small percentage of panelists 29 years of age and younger (5.2%) was used in this study, primarily because younger individuals are more inclined to eat meals away from the home, making them less inclined to participate in at-home cooking tests (Branson et al., 1984). Therefore, a larger percent of consumers were in the 30-49 age group (38.2%) and the 50 and older group (56.6%). Approximately three-fourths of the panelists had attended college or a technical school with one-fourth of the panelists having attained a grammar school or high school education. Income levels ranged from less than $15,000 to over $50,000 per year.

Cooking Method Preferences

The two cooking methods (not presented in tabular form) most often used were pan-frying (37.0%) and oven broiling (34.9%). Although the study was conducted during the month of May, only 22.1% grilled the steaks outdoors. A relatively small percent (6.0%) grilled the steaks indoors. However, the low number in the "grilled inside" category may be due to the lack of the appropriate cooking appliance. The vast majority (86.5%) of the panelists prepared their steaks to at least a "medium" degree of doneness.

Palatability Ratings by Degree of Trimming

Although trends were observed in the data when analyzed by the demographic parameters of age, income level and level of education, these traits were not an important source of variation in consumer ratings of restructured steaks and thus combined, overall ratings of palatability determinations are presented.

The NT steaks received the lowest ratings, IT steaks were rated intermediate and ET steaks were rated highest across all palatability traits studied (Table 1). These results are consistent with the trained sensory panel findings of Recio et al. (1986). Consumers rated ET steaks juicier, more tender and more desirable in flavor and overall, more desirable ($P<0.05$) than NT steaks. Consumers were also asked to evaluate the desirability of "gristle"

present in each steak and found NT steaks to be less desirable ($P<0.05$) in the amount of connective tissue present than both IT and ET steaks. Overall, ET steaks were rated highest in overall desirability and NT steaks were rated lowest ($P<0.05$) among the three trimming treatments.

Likely Replacement Uses and Frequency of Replacements of Restructured Beef Steaks

Listed in Table 2 are likely replacement uses and frequency of replacement per month for restructured beef steaks in substitution of either steak, ground beef/hamburger, sandwich meats and/or chicken. Approximately 31% of the 84 households said they would not replace steak with this product, but 69% responded that they would replace steak with this product at least one time per month. Of this 69%, 91% of the households would replace steak with this product 1-4 times per month.

Forty-six percent of the households would not replace ground beef with this product, with the remaining 54% using this product in the place of ground beef at least once per month. Eighty-four percent of this 54% would replace ground beef with this product 1-4 times per month.

Surprisingly, 65% of the households would not replace sandwich meats with this product. However, in part, this could be due to the actual thickness of the steak (20 mm) presented to the households and the unlikely prospect that a sandwich meat of this thickness would be used. Yet, 35% of the households felt that they would replace sandwich meats with this product at least once per month. Thirty-one percent of the households would replace chicken with restructured beef steaks at least one time per month. A large number (69%) of the households would not replace chicken with this product, suggesting that most consumers perceived it as an alternative to other beef items and not as a product that could replace other meat items such as chicken.

It appears that a large number of the households (67%) perceived this product as intermediate in value ($3.31 - $6.61 per kg) when compared to ground beef prices at

$3.30/kg and T-bone type steak prices at $9.90/kg (Table 3). Only 6% of the households would be willing to pay more than $6.61/kg for this product, with the remaining (19%) willing to pay less than $3.30/kg.

Consumer Preferred Size (Weight) and Thickness For Restructured Beef Steaks

The vast majority of the consumers (94%) responded that this product should be no larger than 270 g (not listed in tabular form). Over 65% of the households responded that the product should weight between 162 - 270 g. Eighty-one percent of the households responded that a desirable thickness for this product would be 17 to 19 mm thick.

DISCUSSION

Results from this study support the findings of Recio et al. (1986). That study suggested that it may not be necessary to extensively trim beef shoulder clods before manufacturing restructured beef steaks. In most comparisons in the present study, consumers were able to detect differences between NT steaks and steaks from either the IT or ET treatments. These findings contradict those of Berry et al. (1984) in that consumers found NT steaks to be objectionable in the amount of connective tissue present within a steak and in addition, rated these steaks lowest in overall desirability. Additional evidence to support the conclusion that extensive trimming of connective tissue is not feasible for use in producing restructured beef steaks is that even in those comparisons where consumers could detect differences between IT and ET steaks, these panelists would not be willing to pay for the added cost of such trimming based on their unwillingness to pay above $6.60/kg.

Once large, heavy pieces of connective tissue were removed from the muscles of the chuck, an acceptable product could be manufactured in the form of a steak that consumers would perceive as an alternative to other beef items.

REFERENCES

Anonymous. 1986. Meat Board Reports, National Live Stock and Meat Board, Chicago, Il. (March issue).

Berry, B.W., Smith, J.J., and Secrist, J.L. 1984. Consumer response to restructured beef steaks processed to have varying levels of connective tissue. Presented at the 44th Annual Meeting of the Institute of Food Technologists, Anaheim, CA, June 10-13.

Berry, B.W., Smith, J.J., and Secrist, J.L. 1986. Effects of connective tissue levels on sensory, Instron, cooking and collagen values of restructured beef steaks. J. Food Prot. 49:455.

Branson, R.E., Smith, G.C., Cross, H.R., Savell, J.W., and Edwards, R. 1984. National Consumer Beef Study: Phase I -- Household Panels. A report to the Agricultural Marketing Service, USDA, Washington, D.C. and to various national and state beef cattle organizations. Texas Agricultural Market Research and Development Center, College Station, MRC 84-1.

Breidenstein, B.C. 1982. Intermediate Value Beef Products. National Live Stock and Meat Board, Chicago, IL. p. 13.

Duncan, D.B. 1955. New multiple range and multiple F-tests. Biometrics. 11:1.

Recio, H.A., Savell, J.W., Leu, R., Cross, H.R., and Smith G.C. 1986. Effect of degree of connective tissue removal on raw material yield, chemical and sensory characteristics of restructured beef steaks. J. Food Sci. 51:1173.

SAS. 1982. SAS User's Guide: Statistics. Statistical Analysis System Institute, Inc., Cary, NC.

Savell, J.W., Francis, J.J., and Cross, H.R. 1986. National Consumer Retail Beef Study. Presented at the 39th Annual Reciprocal Meat Conference, University of Illinois, Urbana, IL, June 8 -11.

Secrist, J.L. 1982. Long-term research needs and goals. In Proc. International Symposium

Meat Sci. and Tech. (Cross, H.R., and Franklin, K.R., Eds.). National Live Stock and Meat Board, Chicago, IL.

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Table 1 -- Mean palatability ratings[a] of restructured beef steaks by degree of trim, normalized data.

Palatability characteristic	Degree of trim[b]					
	NT		IT		ET	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Juiciness	6.4[c]	1.1	6.5[cd]	1.0	6.7[d]	0.8
Juiciness desirability	6.5[c]	1.1	6.6[cd]	1.0	6.8[d]	0.9
Tenderness	6.3[c]	1.1	6.3[cd]	1.0	6.5[d]	1.0
Tenderness desirability	6.4[c]	1.1	6.5[c]	1.0	6.6[c]	1.1
Flavor	6.5[c]	1.1	6.6[cd]	0.9	6.7[d]	1.0
Desirability of "gristle" present	5.8[c]	1.1	6.3[d]	1.5	6.6[d]	1.5
Overall desirability	6.0[c]	1.1	6.3[d]	.96	6.6[e]	1.0

[a]Means based on nine-point scales (see text for definition of scales).
[b]NT = No trim; IT = Intermediate trim; ET = Extensive trim.
[c,d,e]Means on the same line bearing a common superscript letter are not different ($P>0.05$).

Table 2 --Likely replacement uses and frequency of replacement of restructured beef steaks in Houston consumer household panel (n=84 households).

Replacement use	Frequency of replacement/month	Percentage frequency replacement use/month
In place of regular steak	0	30.95
	1	14.29
	2	25.00
	3	10.71
	4	13.10
	5	1.20
	6	2.38
	8	1.20
	10	1.20
In place of ground beef/hamburger	0	46.43
	1	4.76
	2	19.05
	3	11.91
	4	9.52
	5	2.38
	6	3.57
	8	1.20
	10	1.20
In place of sandwich meats	0	65.48
	1	5.95
	2	17.86
	3	3.57
	4	2.38
	5	1.19
	6	3.57
In place of chicken	0	69.05
	1	7.14
	2	9.52
	3	4.76
	4	5.95
	5	2.38
	6	1.19

Table 3 -- Price consumers would be willing to pay for restructured beef steaks.

Dollars/kg	Would buy at stipulated price	
	Percentage	Cumulative percentage
6.61 - 8.80	5.9	5.9
5.51 - 6.60	16.8	22.7
4.41 - 5.50	32.1	54.8
3.31 - 4.40	17.9	72.7
2.21 - 3.30	19.0	91.7
less than 2.20	8.3	100.0