

THE UNIVERSITY OF MANITOBA

THE RELATIONSHIPS BETWEEN CONSUMER CRITERIA
FOR CHOOSING BEEF AND BEEF QUALITY

by

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ABSTRACT

The relationships between consumer criteria for choosing beef and beef quality were examined using rib steaks from 24 animals reared under controlled conditions, selected to provide six experimental sets of steaks each consisting of four distinct marbling levels. Within each set Canada B grade was selected as the lowest marbling level and Canada A grade beef was used for the three higher marbling levels.

When judged by a six member trained sensory panel, broiled Grade A steaks tended to be less chewy and were significantly juicier and more tender than Grade B steaks. Grade differences in juiciness were substantiated by physical measurements with the Carver Press. Physical measurements with the Warner Bratzler shear tended to show that Grade A steaks were more tender than Grade B steaks. No differences in eating quality were apparent among the three marbling levels within the A grade beef.

A sample of 170 consumers demonstrated a statistically significant preference for the visual characteristics of raw Grade B steaks to Grade A steaks. No preferences were evident within the three marbling levels of the Grade A steaks. While the main determinant of preference for most consumers was the amount of marbling, the majority of these did not recognize its significance to eating quality.

When queried about their general steak purchasing practices, the majority of consumers felt the amount of fat and the colour of lean to be their most important criteria for judging steak quality. Very few reported that they paid attention to the colour of fat, or the firmness and texture of lean of raw beef. The beef grading system used prior to

September, 1972 was not meaningful to many consumers in this study, and was not consistently used by them.

Few relationships were evident between consumers' beef shopping and serving practices, and their reported general satisfaction with steak purchases. However, high frequency beef and steak users were generally more satisfied than low frequency users. There was no evidence to suggest that Grade A steak choosers were generally more adept at judging beef quality than were Grade B steak choosers.

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INTRODUCTION

Little research has been conducted in Canada investigating consumer criteria for choosing beef, and consumer satisfaction with beef purchases. At a time when a new beef grading system has recently been introduced in Canada, it becomes increasingly important to relate characteristics of raw and cooked meat to consumer shopping preferences. The objective of this study was to examine these relationships as a prelude to evaluating the new beef grades and their usefulness to consumers.

The basic hypothesis of this research was that selected characteristics of beef, in particular marbling level, could be related to consumer preferences. Marbling level was used as the primary selection criterion for the steaks used in the study, as it was hypothesized that consumers could readily distinguish this characteristic in raw beef, and because marbling is an important determinant of beef grade. However, consumer preferences for other grade determinants were also investigated. These included colour of lean and fat, the amount of external fat, the characteristics of the bone, and the firmness and texture of the lean.

Objective measurements of raw and cooked beef, sensory panel evaluation of cooked beef, and consumer evaluations of raw beef, were the techniques used to examine the relationships between consumer criteria for choosing beef and beef quality. In addition, consumers were surveyed about their meat shopping and serving practices, and their understanding of the beef inspection and grading systems, to examine the relationships between these and general consumer satisfaction with beef purchases.

REVIEW OF LITERATURE

Consumer Preferences for Beef

Consumer studies have shown that the physical appearance of a retail cut of beef in the display case is the most important factor determining retail selection of meat products (Danner, 1959; Dunsing, 1959 b,c). The relationships between specific features of appearance, and the quality of the meat have been the subject of much research in recent years, particularly in the United States. This research followed three main patterns:

1. Visual preference studies.
2. Eating preference studies.
3. Studies of the relationships between sensory attributes and consumer visual preference criteria.

Although proving difficult to define, relationships between the appearance and qualitative characteristics of beef have been established as a result of this research, and are summarized below.

Visual preference studies. Some of the early research involved primarily the recording of impressions or reactions of consumers to visual attributes of steaks and roasts. Consumers were interviewed, often with the aid of photographs or actual samples of beef cuts of particular grades. The respondents were asked which they would prefer, assuming that the cuts could be purchased at equal prices. Rhodes et al. (1955) conducted such a study in Metropolitan St. Louis, where consumers were contacted in retail stores and shown actual samples of uncooked loin steaks and chuck roasts. Their results showed that the largest percentage of consumers selected U.S. Prime grade beef. However, when

a variety of studies are considered, no consistent relationship between preferences and the U.S. grades used prior to 1965 is apparent (Table 1). In studies using photographs, including those of Seltzer (1955) and Stevens et al. (1956), the U.S. Good grade meat was most often selected. Perdue et al. (1958) found that average preferences appeared in reverse order to grade, with U.S. Commercial being first, and Prime last. Studies involving purchases of actual loin steaks by consumers under controlled equal-price conditions (Lasley et al., 1955; Branson, 1957) indicated even higher degrees of preference for the U.S. Good and Commercial grades over Prime and Choice grades, than shown in the studies based on photographs or non-purchased samples.

Table 1
The Percentage of Each Grade of Steak
Selected by Consumers

Grade	Lasley <u>et al.</u> 1955	Rhodes <u>et al.</u> 1955	Seltzer 1955	Branson 1957
Prime	8	34	- ^a	13
Choice	21	27	32	24
Good	28	23	41	44
Commercial	43	16	27	19
Total %	100	100	100	100
Total no.	65	583	491	1978

^aPrime grade not included in study.

These early studies clearly established the fact that not all consumers use the same visual criteria to judge quality when choosing beef. They indicated also that "quality" in beef is not a single attribute but a combination of many characteristics, and that preferences vary significantly among consumers with respect to each of these (Rhodes et al., 1955; Seltzer, 1955; Branson, 1957). Among the important characteristics were external fat covering, marbling, colour of lean, colour of fat, amount of bone, texture of lean, general appearance, and size of package. The order of importance of these differed among the various studies, but the amount of external fat was mentioned most frequently (Table 2). Van Sycle et al. (1958) found that most consumers who considered the amount of external fat in choosing a cut, wanted "some, but not too much" -- that is, an intermediate amount between "the least amount", and "a good amount". Colour, either of the lean or fat, was usually the second most important attribute of the meat. Stevens et al. (1956) found that most U.S. consumers like bright red lean and white fat rather than yellow or dark fat.

Rhodes et al. (1955) found marbling to be the next most important attribute, with a surprisingly large proportion of respondents, 33 percent, indicating a desire for no marbling whatsoever. Branson (1957) on the other hand, found that consumers were generally unconcerned with the marbling of beef. Seltzer (1955) found that 59 percent (288) of the 491 consumers interviewed in his study preferred steaks with the least amount of marbling, while 18 percent (89) selected a cut showing a moderate amount of marbling, and 23 percent (114) picked a highly marbled steak.

Table 2
The Order of Importance of Visual Characteristics
for Judging Beef Quality

Characteristic	Rhodes <u>et al.</u> 1955	Seltzer 1955	Branson 1957
Amount of external fat	1	1	2
Amount of marbling	2	3	5
Colour of lean	3	2	1
Colour of fat	5	4	3
Amount of bone	6	5	4
Texture of lean	4	6	6
<hr/>			
Total no. respondents	583	491	987

Eating preference studies. Subsequent studies in the United States were more concerned with establishing "eating" or "sensory" preferences for beef. This required studies in which preferences were recorded after samples of cooked meat had been tasted or eaten. Accordingly tests were made using both laboratory and household consumer panels. As research continued in this area, it was found that the relationships between physical attributes of raw beef and consumer preferences or eating satisfaction were considerably more complex than had been previously thought. As stated by Cover (1956) in summarizing some of her forty years of work on the relationship of fatness in steers to palatability, "It is disconcerting that something which has appeared so obvious to so many for so long should be so extraordinarily difficult to

prove in the laboratory".

However, it has been established that eating quality is made up of several attributes including tenderness, flavour, juiciness and aroma. One researcher (Cover, 1957) distinguishes between several different attributes of tenderness such as "softness", "friability", and "tenderness of the residual connective tissue". However, Harries et al. (1972) found by using factor analysis that the texture of beef, as recorded by a trained taste panel, could be reduced to two independent factors, with a discard of total variation of only 5 percent. The texture of beef could then be appreciated by two sensations -- one of "toughness-tenderness" and one of "juiciness" -- and more elaborate subdivisions of sensations in the mouth did not add appreciably to the precision of sensory assessment.

Dunsing (1959 d) found that about three-fourths of the members of a sensory panel had identical preferences for the overall eating quality of beef of different grades, and for two or three of the specific eating factors tested such as tenderness and juiciness. The variability in responses however, was much greater for the specific eating factors than for overall eating quality. The results suggest that the panel members differed considerably in the relative importance which they attached to the specific factors in terms of providing eating satisfaction. This may explain why only small average differences between U.S. grades have been indicated. In reporting results of a laboratory panel, a Missouri study indicated that the grades Choice, Good and Standard were rated much the same for tenderness, flavour and juiciness (Rhodes et al., 1958). In another Missouri study by Rhodes et al. (1956) it was found that taste testers were only slightly more successful in distinguishing

between loins from different grades than between loins from the same grade.

Relationships between sensory attributes and consumer visual preference criteria. Low correlations characterize the relationships between the sensory attributes of beef, and visual preference criteria such as marbling, colour of lean and fat, amount of external finish, firmness and texture.

Cover et al. (1956) report that "... the agreement between fatness and tenderness in beef is low enough that it is not surprising that a consumer who buys fat loin steaks or even well marbled loin steaks is sometimes disappointed in their tenderness". In a more recent study involving shear force values and taste panel scores of beef loin and bottom round steak, Cover (1960) reports that "carcass grade and marbling were not consistently nor closely related to measures of connective tissue or muscle fibre". Norris et al. (1971) found that panel scores for tenderness, juiciness, flavour, and overall acceptability and Warner-Bratzler shear values were not affected significantly by level of maturity or marbling.

However, other researchers have found that marbling is important to beef palatability. Wellington et al. (1959) found that panel tenderness and juiciness scores were significantly correlated with marbling score ($P < 0.01$ and $P < 0.05$ respectively). That is, as marbling increased, so did tenderness and juiciness. However, while significant, marbling accounted for only 6.9 percent of the variability in tenderness and 3.5 percent in juiciness. Simone et al. (1959) found that well marbled roasts (Choice grade) were significantly more tender than those with

less marbling (Good grade).

The most convincing research regarding the effect of marbling on beef palatability indicates that a minimum amount of marbling is necessary if beef is to have a high potential for consumer satisfaction. Doty and Pierce (1961) found a significant relationship between marbling and tenderness and juiciness scores (Table 3). However, the relationship with juiciness was curvilinear, in that it was not apparent when marbling was rated above moderate to slightly abundant. Field et al. (1966) found that roasts with modest amounts of marbling received significantly higher sensory ratings of tenderness, flavour and juiciness than did those with small amounts or less marbling (Table 4). This agrees with Covington et al. (1970) who found that shear force of cooked longissimus dorsi was lower for the moderate than for the small level of marbling. While the results of Breidenstein et al. (1968) revealed little effect of marbling on tenderness, they did reveal that well marbled steaks and roasts were significantly more flavourful and juicier than those with less marbling.

Colour of both the lean and fat are important factors in consumer visual acceptability of beef (Dunsing, 1959 b,c; Rhodes et al., 1955). However, the colour of lean has been shown to have little effect on the sensory attributes. Breidenstein et al. (1968) and Jeremiah et al. (1972) found that mean scores for flavour, juiciness and tenderness did not differ among steaks in different colour score groups. Their data suggest that muscle colour is not an accurate indicator of beef palatability. There is some evidence, however, that suggests that colour of fat has some influence on the flavour of beef. Malphrus (1957), found that a highly significant number of tasters were able to detect a difference in

taste of steak with white fat as compared to steak with yellow fat, when all fat was removed prior to tasting (Table 5). There was also a highly significant proportion expressing a preference for steak with white fat among tasters who detected a difference in taste.

Table 3
Linear Correlation Coefficients Between Marbling Level
of the Rib Eye and Tenderness and Juiciness
(Doty and Pierce, 1961)

CORRELATION COEFFICIENTS						
PARAMETER	Aging Period (weeks)					
	0		2		4	
	n	r	n	r	n	r
Tenderness:	42 ^a	0.56**	39	0.33*	20	0.60**
	34 ^b	0.20	34	0.37*		
Juiciness:	42	0.59**	39	0.82**	20	0.78**
	34	0.49**	34	0.54**		

*, ** Significant at $P < 0.05$ and $P < 0.01$ respectively.

^{a, b} First and second years of study respectively.

Table 4

Least-squares Estimates of the Effects of Marbling
on Sensory Tenderness, Flavour and Juiciness
for Bulls and for Steers and Heifers
(Field et al. 1966)

Least-squares Estimates						
Marbling	Tenderness ^d		Flavour ^d		Juiciness ^d	
	Bulls ^e	S & H ^f	Bulls	S & H	Bulls	S & H
trace	-0.45 ^a	-0.50 ^{a,b}	-0.22 ^a	-0.32 ^a	-0.44 ^a	-0.39
slight	-0.34 ^a	0.11 ^{a,b}	-0.12 ^a	-0.47 ^a	-0.01 ^a	-0.10
small	-0.39 ^a	-0.99 ^b	-0.12 ^a	-0.14 ^a	-0.25 ^a	-0.07
modest	1.04 ^b	0.54 ^a	0.41 ^b	0.27 ^b	0.39 ^b	0.17
moderate	0.14 ^{a,b}	0.44 ^a	0.05 ^{a,b}	0.66 ^c	0.31 ^b	0.39

^{a,b,c} Deviations from the overall mean within a column bearing different superscript letters differ significantly ($P < 0.01$). Constants are expressed as deviations from the overall mean, which are attributed to the differences in marbling.

^d Scoring system: 9 = like extremely. 1 = dislike extremely.

^e Bulls: $n = 134$

^f Steers and heifers (S & H): $n = 84$.

Table 5
Relationship Between Colour of Beef Steak Fat
and Consumer Taste Preferences for Lean
(Malphrus, 1957)

No. of tasters	Difference observed		Preference	
	Yes	No	Yellow	White
33	22	11	12	11
36	26**	10	12	14
32	23*	9	8	13
36	23	13	3	19**
36	29**	7	6	23**
36	28**	8	8	20*
209	151**	58	49	100**

*,** Significant at $P < 0.05$ and $P < 0.01$ respectively.

External finish of beef, as measured by the fat cover on the carcass, has not been found to affect the sensory attributes. Cover et al. (1956) concluded that finish is not a reliable indicator of tenderness in beef. Doty and Pierce (1961) found that the correlation between fatness and tenderness was high in unaged muscle but became less pronounced or absent in aged muscle. Larmond et al. (1968) found that as far as tenderness of the longissimus dorsi and the semimembranosus of beef was concerned, there seemed to be no advantage in using more expensive high finish cattle, rather than low finish cattle, when both were aged from 9 to 16 days.

Breidenstein et al. (1968) found that the subjective muscle evaluation of firmness of raw loin steaks was related to beef palatability (Table 6). Muscles which contained slightly abundant and abundant amounts of marbling were significantly firmer than those which contained slight and modest amounts of marbling. Similarly Pilkington et al. (1960) reported positive correlations of about 0.9 between measures of firmness and fat content. That is, as fat content increased firmness tended to increase, and as firmness increased, so did beef palatability. Breidenstein et al. (1968) found that the correlation of muscle firmness to all palatability scores including tenderness, juiciness, flavour and general opinion of acceptability were highly significant.

Table 6

Muscle Firmness and Texture as Related to
Palatability Characteristics
(Breidenstein et al., 1968)

Parameter	Correlation Coefficients ^a	
	Muscle firmness	Muscle texture
Shear force	-0.07	0.49**
Panel tenderness	0.34**	-0.37**
Panel juiciness	0.56**	0.09
Panel flavour	0.65**	0.10
Panel general opinion score	0.48**	0.22

** Significant at $P < 0.01$.

^a n = 60

Texture, subjectively evaluated as fine (1), acceptable (2) and coarse (3) was also found by Breidenstein et al. (1968) to be related to the palatability of beef (Table 6). Texture was positively correlated with shear force and negatively with mean tenderness score ($P < 0.01$). That is, the coarser steaks were less tender than the fine grained steaks. The other palatability scores including juiciness, flavour and general opinion were not found to be related to texture.

Beef Grading in Canada

Functions and history of the beef grading system. Grading is a process of classifying units of a variable commodity into groups which are more homogeneous in certain characteristics than the entire set, according to established and generally accepted criteria. Beef grading involves the systematic classification of the supply of beef into categories having similar quality characteristics, and reflecting differences which are important to the various segments of the beef industry. If these segments have confidence in the categories established, grading provides a standard basis for buying and selling in all transactions from the producer to the consumer, and permits each quality to find its proper level in the market according to general acceptability (Maybee, 1964). To be of any value to the consumer then, grading must take into consideration those factors previously outlined as being important to consumer preferences.

Until the advent of government grading, there was no uniform assurance to consumers of the quality of the beef they were buying. At the same time producers were not directed to produce the most preferred highly finished beef, as they were not realizing returns commensurate

with the additional feed and labour required. To remedy this situation, a government beef grading service gradually developed which took into consideration the following characteristics of a carcass:

1. type or conformation; the ratio of meat to bone.
2. fleshing; the amount and distribution of lean meat.
3. finish; the fat covering on the outside of the carcass, its thickness, smoothness and distribution.
4. quality; factors such as colour and texture of lean and fat, and the condition of the carcass.

While the original beef grading service, inaugurated in 1929 on a voluntary basis, seemed to be somewhat arbitrary and limited in its use, it did define two grades of beef, Choice and Good. In the years following, the grading system underwent a series of important changes and expansions, and in 1948 specifications for eight national grades were established. In 1958 the national grading system was expanded to include a "Standard" grade, and to subdivide the already established "Commercial" grade further, making a total of eleven different beef grades. These included Canada Choice; Canada Good; Canada Standard; Canada Commercial 1, 2 and 3; Canada Utility 1, 2 and 3; Canada Manufacturing; and Canada Bull. Requirements for each of the classification factors of type or conformation, fleshing, finish and quality varied for any given grade according to the sex, weight and age of the animals (Maybee, 1964).

Reasons and research behind the changes in the grading system.

As time progressed it became apparent that the grading system established in 1958 was not completely satisfactory. During discussions

held across the country it became clear that there was no single, simple problem or issue regarding the question of grading, but if one were to pick one word that recurred more often than any other it was "fat" (Anon., 1966). Controversy resulted in the charge that fat was too important in the system for several reasons:

1. Too many carcasses in the Choice grade carried surface fat that was unnecessarily high in relation to;

- a. consumer preference, and
- b. requirements for flavour and tenderness in animals of the age customarily marketed.

2. The live basis of selling used at public stockyards put a premium on fat cover that was unnecessary and inefficient, because the buyer buys on prospective yield and grade, yield being based on the dressed carcass.

3. The grading system did not look at the fat-lean relationship in the cuts -- for example, as measured by the area of the eye of the loin, and the rib fat measurements. Thus some carcasses that were distinctly overfat, or large-boned, were nevertheless grading Choice by the 1958 standards. This criticism implied that grading should in part be based on examination of the rib cut in a carcass (Anon., 1966).

4. The costly process of fattening animals so they would reach the top grades, was followed by another costly process -- trimming off the surplus fat and discarding it at little or no return. Thus the industry was paying a bonus for fat at one stage, and turning about to discount the same product at a later stage (Berg, 1969).

These and other criticisms led to extensive research into prospects for a new beef grading system in Canada. While much research into

establishing objective criteria for evaluating quantity and quality of lean in the beef carcass had been conducted, particularly in the United States, further efforts were deemed necessary before the new system could be drawn up. As a result, research into this area was initiated at Lacombe, Alberta, in 1967. The main conclusions, as summarized by Fredeen (1972) were as follows:

1. Measurement of quantity;

- a. Lean yield, or proportion of edible product, in the beef carcass is directly related to the average depth of fat cover over the longissimus dorsi, carcass weight being constant (Martin et al., 1970). The percent yield of externally defatted product (bone in) is reduced approximately 1.2 percent for each increase of 1.5 cm. in total rib fat, when the area of the longissimus dorsi is held constant. Conversely, when fat is held constant, each increase of 12.9 sq. cm. in longissimus dorsi area results in an increase of 0.5% in percent yield (Fredeen, 1972).

- b. Heifers averaged 200 pounds lighter in carcass weight than steers, but when compared on an equal weight basis, had approximately the same rib eye area and slightly greater fat over the rib eye. However, this extra fat was largely offset by less bone (1%), with the result that heifers were virtually equivalent to steers in the proportion of boneless defatted product (Fredeen et al., 1970; Fredeen et al., 1971).

2. Measurement of quality;

- a. Marbling was not associated with tenderness, juiciness or flavour as determined by taste panel evaluation of steaks from the longissimus dorsi. The correlations, while positive, were exceedingly

small, ranging from 0.01 to 0.20, indicating that variation in degree of marbling explained less than 4 percent of the variance in attributes of eating acceptability (Martin et al., 1971 b).

b. Meat colour bore no relationship with tenderness, juiciness or flavour except in the case of "dark-cutting" beef from young bulls exposed to pre-slaughter stress. Such dark-cutting beef was rated by the taste panel as significantly ($P < 0.05$) superior in all attributes of eating acceptability (Martin et al., 1971 a).

c. For steers and heifers, there were no meaningful associations between carcass lean content or fat cover, and tenderness, juiciness or flavour of the meat (Fredeen, 1972; Martin et al., 1971 b).

d. There was no evidence of any interaction between measures of carcass fatness and aging effects -- that is, cooler aging of the carcasses resulted in a relatively large improvement in tenderness during the first six days post mortem, but neither the rate nor degree of change in tenderness was influenced by the amount of fat cover on the carcass (Martin et al., 1971 b).

e. Carcass pH was not a useful indicator of potential tenderness as measured objectively by the Warner-Bratzler shear, or subjectively by a taste panel (Fredeen, 1972).

The new grading system. Based largely on these results a new grading schedule has been developed which takes into consideration maturity, quality factors, and carcass weight. In addition it incorporates objective measures of fat cover at the rib eye to predict meat yield.

The maturity of the animal affects the quality of the beef in

that the older the animal, the less likely it is that the carcass will produce tender cuts of beef (Dunsing, 1959 a; Hiner et al., 1950; Martin et al., 1971 a). Maturity of the carcass is determined by the skeletal characteristics, including the appearance of bones and cartilage. On that basis, the carcasses are divided into one of three Maturity Classes, I, II, or III -- that is, youthful animals, not including veal carcasses, intermediate aged animals, and mature aged animals respectively (Statutory Orders and Regulations, 1972).

Quality factors including colour, texture and firmness of the fat and lean, are taken into consideration in the new grading system. While not all of these have been shown to affect eating preferences for beef, they have been shown to affect visual preferences. Thus the grading system is based on the premise that the potential eating satisfaction of meat is rarely realized if the cut is deficient in eye appeal. In addition, possibly due to the controversy surrounding the importance of marbling to beef palatability, the amount of intramuscular fat is considered to some extent in the new beef grades. The grading system assumes then, that carcasses with lean meat that is bright red, firm, and fine grained in texture, with some marbling and a firm, white fat cover will produce cuts of meat with the greatest potential for consumer satisfaction. To facilitate judgement of these quality traits the new grading system provides for all sides of beef to be "knife-ribbed" -- that is, cut midway between the eleventh and twelfth ribs without severing the backbone, so as to expose the rib eye muscle and the exterior fat layer (Statutory Orders and Regulations, 1972) (Figure 1).

The new schedule also provides a precise definition of a "carcass", which enumerates what must be removed prior to weighing. In view of the fact that lean yield varies depending on the fat cover and

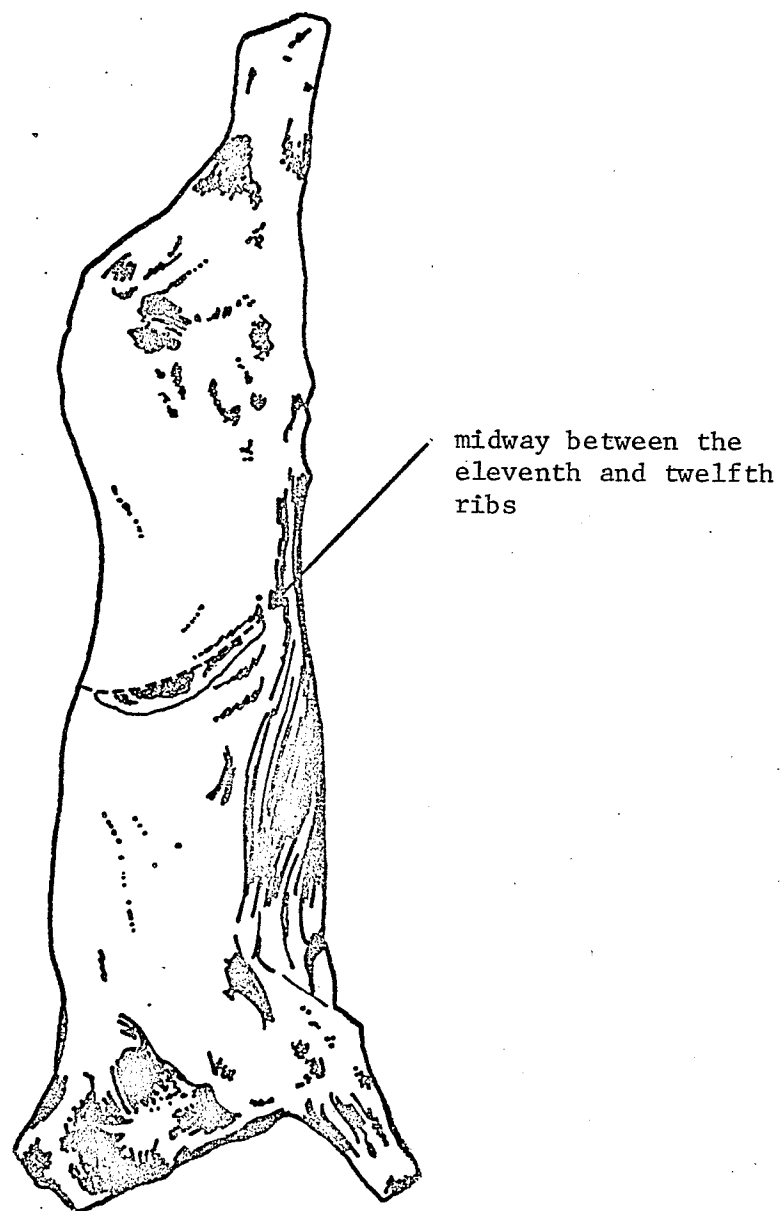


Figure 1. Location of Knife-ribbing

warm carcass weight, what is included in determining this weight is important. The precise definition of a carcass then insures standardized procedure in all processing plants (Anon., 1972).

After maturity and quality levels, and warm carcass weight have been established, the fat cover of carcasses qualifying for the two best quality grades is measured at the minimum point in the fourth quarter from the vertebrae, along the longitudinal axis of the rib eye (Figure 2). Based on these measurements, the carcasses are assigned a final grade (Anon., 1972).

The new grading schedule which was inaugurated on September 5th, 1972, consists of nine grades, where eleven existed previously. These are Canada A; Canada B; Canada C, Class 1; Canada C, Class 2; Canada D, Class 1; Canada D, Class 2; Canada D, Class 3; Canada D, Class 4; and Canada E. The greatest effect of the new grades will be on carcasses graded Canada A or B, because it is these grades to which the concept of meat yield has been added. Thus Canada A and B quality grades are subdivided into four fat categories depending on the degree of external finish at the rib eye (Table 7) (Anon., 1972).

The majority of retail outlets in Western Canada carry primarily Grade A, and perhaps some Grade B beef. Thus only the characteristics of these two grades of beef will be outlined here. To qualify for either of these grades, animals must have the bone condition as described for Maturity Class I or youthful animals. In addition, they must be free from marked deficiency in muscling as evidenced by a medium to large rib eye muscle relative to carcass weight, and by freedom from marked angularity and depressions in the hips and chucks and by freedom from narrowness through the loins and ribs (Statutory Orders and Regulations, 1972).

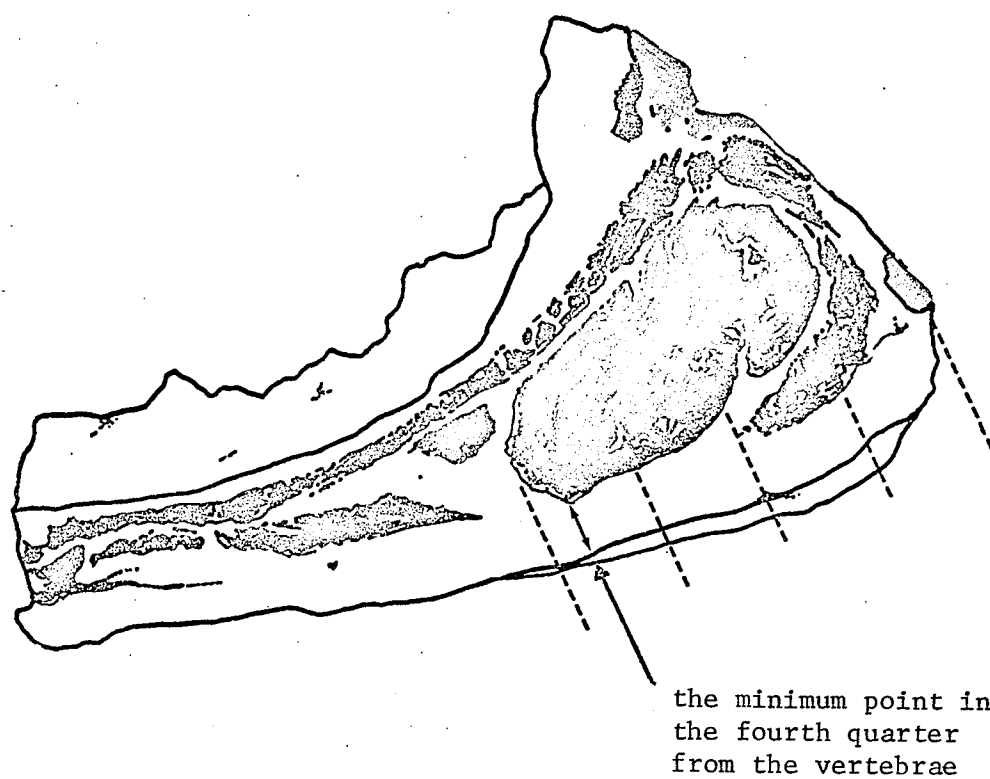


Figure 2. Location of Fat Cover Measurement

Table 7

Fat Categories for Canada A and Canada B Grades

FAT LEVEL FOR CANADA A

Warm carcass weight	1	2	3	4
pounds	in.	in.	in.	in.
300 - 499	.20 - .30	.31 - .50	.51 - .70	over .70
500 - 699	.20 - .40	.41 - .60	.61 - .80	over .80
700 and over	.30 - .50	.51 - .70	.71 - .90	over .90

FAT LEVEL FOR CANADA B

Warm carcass weight	1	2	3	4
pounds	in.	in.	in.	in.
300 - 499	.10 - .30	.31 - .50	.51 - .70	over .70
500 - 699	.10 - .40	.41 - .60	.61 - .80	over .80
700 and over	.20 - .50	.51 - .70	.71 - .90	over .90

Canada A beef carcasses must have the following minimum quality characteristics:

1. The longissimus dorsi muscle, when exposed by ribbing, is firm and fine grained and of a bright red colour, and marbling is at least slight.

2. The fat covering extends well over the exterior surface but may be somewhat lacking on the hips or the chucks and is firm, white or slightly tinged with reddish or amber colour.

3. Fat levels 1, 2, 3 and 4 shall be determined by measurements as described in Figure 2 and Table 7.

Canada B beef carcasses must have the following minimum quality characteristics:

1. The longissimus dorsi muscle when exposed by ribbing is moderately firm, with the colour ranging from bright red to medium dark. The texture of the flesh may be somewhat coarse and there shall be no minimum marbling standard.

2. The exterior fat may be somewhat lacking on the hip and chuck, range in colour from white to pale yellow, and is firm or slightly soft.

3. Fat levels 1, 2, 3 and 4 shall be determined by fat measurements, as described in Figure 2 and Table 7.

Further research has been proposed to test consumer response to meat graded by the new standards. Hopefully this will reveal the relationships between consumer criteria for choosing beef and beef quality. This should in turn enable us to evaluate, to some extent, the usefulness of Canada's new beef grading system to consumers.

METHOD

"Rib steaks", defined here as steaks with the longissimus dorsi muscle predominating, of Canada A and B grade beef of four pre-established marbling levels were used to examine the following:

1. The relationships between marbling level, and the percent ether extract, percent protein content, percent moisture content and rib eye area of beef steak.
2. The relationships between marbling level and grade, and the sensory attributes of firmness, juiciness and chewiness of beef steak.
3. The relationships between marbling level and grade, and consumer visual preferences for beef steak.
4. The relationships between marbling level and grade, and the characteristics used by consumers to establish visual preferences for beef steak.
5. The relationships between the characteristics used by consumers to establish visual preferences for beef steak, and the indication of these characteristics to consumers.
6. The relationships between consumer satisfaction with beef steak purchases and the characteristics used by consumers to judge quality in raw and cooked steak.
7. The relationships between consumer satisfaction with steak purchases and consumer beef shopping habits and preferences.

For the purpose of studying these relationships, the following tests were conducted:

1. Laboratory testing
 - a. Objective tests on raw steaks

- b. Objective tests on cooked steaks
 - c. Sensory tests on cooked steaks
2. Consumer evaluation
- a. Consumer visual preferences for raw steaks
 - b. Consumer questionnaire

Experimental Design

Rib steaks of Canada A and B grades were carefully selected, under the direction of a meats physiologist, to fulfill a requirement for seven experimental sets of steaks, each consisting of four distinct marbling levels. The steaks were selected in June, 1972 to conform as closely as possible to the final draft of the Beef Carcass Grading Regulations, which became effective September 5th, 1972. Within each set, B grade was selected specifically as the lowest marbling level, and A1 and A2 grade beef was selected, in no particular sequence, for the other three marbling levels (Table 8). Each of the seven sets was examined cooked, to establish objective and sensory measurements of beef quality, with the same trained six member sensory panel judging each set. In addition, each of the seven sets was examined raw, to establish objective measurements of proximate analysis and rib eye area, and by 27 to 29 different consumers to establish consumer visual preferences of 198 people. Opinions concerning consumer shopping habits and preferences, understanding and use of beef inspection and grading, and general satisfaction with steak purchases were obtained in conjunction with the viewing of the raw steaks.

Due to an experimental error in the assignment of grades to marbling levels, the results of one set of steaks could not be used in the analysis. However, where consumer responses were not influenced by viewing the actual steaks, the responses of a total of 198 consumers were included in the analysis. All other data involves six sets of four

marbling levels each, and a total of 170 consumer responses.

Table 8
Grades and Marbling Levels of Rib Steaks
Within Experimental Sets

SET	MARBLING LEVELS ^a			
	1	2	3	4
I	B1	A1	A1	A1
II	B1	A2	A1	A1
III	B1	A1	A2	A2
IV	B1	A1	A1	A1
V	B1	A1	A2	A2
VI	B1	A1	A1	A1
VII	B1	A1	A2	B1 ^b

^a Level 1: equivalent to the U.S.D.A. level of "Practically devoid" or less.

Level 2: equivalent to the U.S.D.A. level of "Slight amount". (This is also the C.D.A. minimum for Grade A carcasses under the new grading system).

Level 3: equivalent to the U.S.D.A. level of "Small amount".

Level 4: equivalent to the U.S.D.A. level of "Modest amount".

^b Data from this set were not included in the analysis, due to an error in assignment of grades to marbling level.

Handling and Selection of Samples

Rib steaks from 24 animals, all from the foreign cattle breed evaluation herd were obtained from the C.D.A. Research Station at Brandon. Breeding and management of the animals were described by G. W. Rahnefeld et. al. (1972). The animals were slaughtered, as they achieved

1,000 \pm 20 lbs. live weight, and were between 12 and 14 months of age. The carcasses were selected to fulfill a requirement for six sets of steaks, each consisting of four pre-established marbling levels. Marbling level was used as the primary selection criteria, to aid visual sorting by consumers. Other quality determining differences such as colour and texture were held to a minimum to ensure that marbling level was the most prominent difference between the sample steaks. The marbling levels of the sample steaks were determined by visual examination of the rib eye at the eleventh and twelfth interface on the right side of each carcass. Qualified personnel of the C.D.A. Research Station staff conducted all sampling procedures. Samples typical for the respective marbling levels were selected, to limit biological variation. Rib eye areas were determined at this time.

Following slaughter, the carcasses were aged nine days at 2°C. \pm 1° and on the ninth day were broken into wholesale cuts. The left wholesale loins, beginning with the twelfth thoracic vertebrae were removed to the Brandon Research Station Meats Laboratory, where steak samples were cut serially, wrapped individually in polyethylene bags and polycoated freezer wrap, and frozen at -32°C. After freezing for 24 hours, the samples were packed in boxes and stored in the same freezer until transported by refrigerated truck to the University of Manitoba laboratory. Samples from the right wholesale loin, adjacent to the eleventh rib, were frozen and stored in Brandon, where proximate analysis was conducted at a later date.

The serially cut steak samples were stored at -32°C. to -40°C. until required for experimental purposes. Each of the six sets included five adjacent steaks at each of the four marbling levels. Beginning at

the anterior end of the loin piece, the five steaks were designated for testing as follows:

Steaks nos. 1 and 2	Sensory tests
Steaks nos. 3 and 4	Objective tests
Steak no. 5	Consumer evaluation

Steaks numbered 1 through 4 were each approximately 3 cm. thick. Steak number 5 was approximately 5 cm. thick, and was later separated into two steaks, each approximately 2.5 cm. thick.

Laboratory Testing

Objective tests on raw steaks.

1. Proximate analysis.

Percent moisture, protein, and ether extract were determined for each of the 24 steaks comprising the six sets of four marbling levels, according to the methods outlined in Appendix A. All samples were run in duplicate and were repeated if the values failed to agree.

2. Rib eye area.

The rib eye areas, or cross-sectional areas of the longissimus dorsi at the eleventh and twelfth interface, were traced on acetate paper and measured with a compensating polar planimeter.

Objective tests on cooked steaks.

1. Handling of the steaks.

In preparation for assessing tenderness and juiciness, steaks of all four marbling levels from each of the six sets were cooked by broiling. The steaks used were transferred, one set at a time, to a home style upright electric freezer where they were held at -18°C . for

26 hours. Subsequently they were transferred to a home style electric refrigerator and allowed to thaw completely at 4°C. for 40 hours.

Prior to cooking, the fat and connective tissue were scored to prevent curling of the meat. All steaks were broiled, four at a time, approximately 6.5 cm. below the element to an internal temperature of 45°C. At this stage they were turned and broiling was continued until they reached an internal temperature of 70°C. One home style electric range was used throughout the experiment. Internal temperature was monitored by copper-constantan thermocouples randomly assigned and inserted into the meat. A Honeywell recording potentiometer constantly recorded the temperature of the meat as cooking progressed. The steaks were allowed to cool thirty minutes after cooking before being further examined.

2. Percent cooking losses.

The steaks were weighed immediately prior to and thirty minutes after cooking. Total cooking losses, that is drip loss plus evaporation, were calculated as percentages of the raw weight for each steak.

3. Shear force.

The Warner-Bratzler shear (Model #69061103) was used to estimate meat tenderness. Cores, 1.27 cm. in diameter, were removed parallel to the grain from the medial, central and lateral positions of each steak. Each core was then sheared perpendicular to the grain three times. The average shear force value of the nine measurements (3 readings x 3 cores) was taken to represent the shear force value for each steak.

4. Relative fluid holding capacity.

The Carver Laboratory Press, Model C, was used to estimate

press fluid. Four 0.50 gm. slices, approximately 1 mm. thick were removed from freshly cut surfaces adjacent to the shear force cores throughout each steak. Each sample was sandwiched between a piece of Whatman no. 1 qualitative filter paper and a piece of aluminum foil, then placed between two plexiglass plates. The four samples were stacked, making a total of five plexiglass plates, and then were subjected to 15,000 lbs. pressure for ten seconds and released.

During pressing, two distinct rings were formed on the filter paper (Figure 3). The innermost ring (A) represented the circumference of the pressed meat, and the outermost ring (B) the circumference of expressed liquid. Immediately after the unit was removed from the press, B was traced with pencil, and the pressed meat was removed. A was distinct without tracing, and did not change when the filter paper dried.

A compensating polar planimeter was used to obtain the areas of pressed meat (C) and expressed fluid (D) (Figure 3). According to the method of Miller and Harrison (1965), the expressible-fluid index was calculated as the ratio C:D. Unity arbitrarily was assumed as the maximum expressible-fluid index for any particular sample of cooked meat, and the relative fluid holding capacity as: $1.0 \text{ minus expressible-fluid index}$. The average relative fluid holding capacity for the four samples was taken to represent the juiciness score for each steak.

Sensory tests on cooked steaks. The six sets of steaks were evaluated by the same six member trained sensory panel, for the subjective quality measurements of firmness, juiciness and chewiness. Preparation of the steaks followed the same pattern as outlined for the objective tests on cooked steaks.

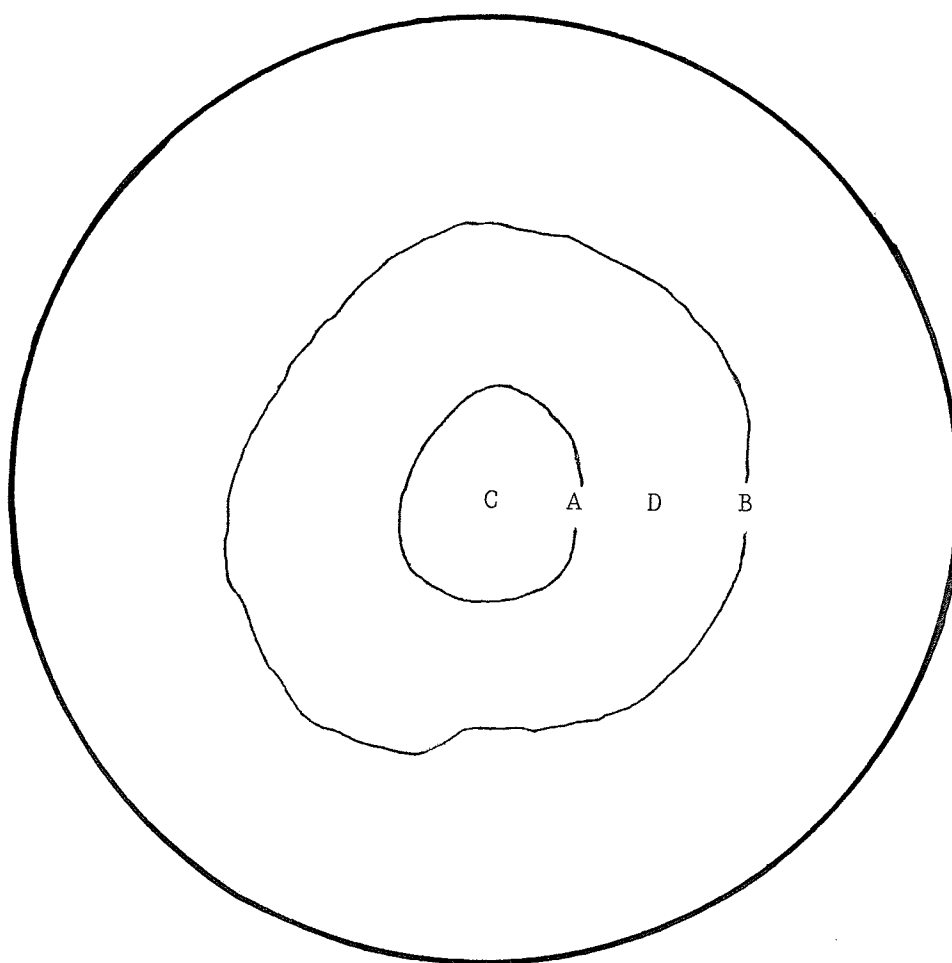


Figure 3. Diagram Illustrating the Circumference and Area of a Pressed Meat Sample and its Expressible-fluid as Marked on Filter Paper

A = circumference of pressed meat sample

B = circumference of expressed-fluid

C = area of pressed meat

D = area of expressed-fluid

1. Panel selection and training.

A six member panel consisting of summer students and staff members of the Department of Foods and Nutrition, University of Manitoba, was selected to participate in the study, on the basis of their interest in the project and availability to perform as panelists. All training and sensory evaluation sessions were conducted in an air conditioned laboratory at a large table to facilitate group discussion.

The training sessions for sensory evaluation took place over a six week period, and were divided into three relatively separate stages.

The first stage was designed to acquaint the panelists with the terms used in general texture description. Panelists were presented with the texture scales devised by Szczesniak et al. (1963) for judging hardness, fracturability, adhesiveness, viscosity and chewiness. These consist of 7 to 9 point scales which use standard foods as anchors for all or some points on the scale. This enables the judges to define accurately a certain level for each parameter, such as firmness.

During the second stage of training, samples of meat were presented along with the standard scales for firmness and juiciness of beef, using food standards accessible in Canada, developed by McLandress (1972). As training progressed, the descriptive terms used, the size of the samples and the methods used to judge the samples were clarified by trial and subsequent discussion, and finalized as outlined in Figure 4. Throughout this second stage, the anchored scales were changed and refined so that food standards representing a narrower range for the dimensions of firmness and juiciness were used. The anchored scales which the panel formulated for use in sensory evaluation are shown in Figure 4.

Definitions for the sensory dimensions for the evaluation of beef:

- firmness; is the force required to compress a $\frac{1}{2}$ " cube of meat across the grain, between the molar teeth.
- chewiness; is the number of chews required before a $\frac{1}{2}$ " cube of meat is ready for swallowing.
- juiciness; is the amount of moisture in the mouth after 3 chews between the molar teeth, on a $\frac{1}{2}$ " cube of meat.

Anchored scales used by panelists for the evaluation of beef:

Parameter & Intensity	Food Product	Brand	Particulars	Preparation
Firmness				
1	Cheddar cheese	Kraft	Medium	$\frac{1}{2}$ " cubes
2	no anchor	-	-	-
3	Gum drops	Paulins	AB Gums	top & bottom removed
4	Salami	Blue Label	-	$\frac{1}{2}$ " cubes
5	Baking gums	McCormicks	-	1 gum drop
6	Caramels	Kraft	Vanilla	sliced in half
7	no anchor	-	-	-
Juiciness				
1	Shortcake biscuit	Peek Frean's	-	$\frac{1}{2}$ " sq. piece
2	no anchor	-	-	-
3	Evaporated apples	Sunripe	Slices	$\frac{1}{2}$ " sq. piece
4	Raisins	Sugaripe	Seedless	1 raisin
5	Canned potatoes	Culverhouse	Small, whole	$\frac{1}{2}$ " x $\frac{1}{2}$ " x $\frac{1}{4}$ " piece
6	Water chestnuts	China Lily	-	$\frac{1}{2}$ " x $\frac{1}{2}$ " x $\frac{1}{4}$ " piece
7	Canned mushrooms	Taste-tells	Whole, button	$\frac{1}{4}$ of mushroom cap

Figure 4. Definitions and Anchored Scales Used by Panelists

The third stage of training was designed to reduce inter-panelist variability in judgement -- in effect to calibrate the panelists, one to the other, and to the definitions developed. This involved presenting each panelist with cooked meat samples from the same longissimus dorsi muscle, and requiring them to rate the samples in relation to the standards on the scales. For example, for firmness, a panelist might have rated the sample equal to the salami. Each panelist rated the coded samples individually for the three parameters, and then the group discussed the rating under the guidance of the panel leader. If there was disagreement, the panelists retasted the samples until unanimously acceptable levels of firmness and juiciness were agreed upon. Individual counts were used to establish chewiness. As the panelists became more familiar with the scales, the food standards were assigned values along 7 point scales, with a value of 7 representing the highest intensity and a value of 1 representing the lowest intensity of the sensation. Subsequently, the panelists rated the samples numerically. Group discussions, and when necessary retasting, were continued. Training was considered to be adequate when the panelists were able to judge a set of samples from four steaks, within a range of 2 points on the 7 point scales, with no retasting being necessary.

2. Sensory evaluation.

Using the scales developed during the training, the six panelists judged the six sets of four marbling levels, judging each set on a different day, within six consecutive week days.

A standard preparation procedure was followed each day. After cooking and cooling, the steaks were trimmed of all fat and outside edges, leaving only the rib eye area or the longissimus dorsi muscle as the

experimental material. Five $\frac{1}{2}$ in. cubes of meat from each marbling level, enough to allow judgement of all three parameters, were placed in separate coded plastic bags for each panelist, and secured with twisters. Each panelist received a tray set with four bags or one complete set of meat samples, the standards for the anchored scales, a list of definitions and scales (Figure 4), a water cup, an expectoration cup, a score sheet and a pencil. The trays were set immediately prior to panel time to ensure freshness of the standards and samples. All samples and standards were served at room temperature.

Panel sessions were held at 11:10 A.M. of each testing day. The panelists were permitted to swallow or expectorate any samples as desired, and were given as much water to drink between samples as they wished. They were instructed to evaluate the 3 parameters at will, for two samples consecutively in a predetermined random order. Individual judges' scores for each parameter were recorded for statistical analysis. Under the direction of the panel leader, group discussion and retasting followed, to establish unanimity for single levels of hardness and juiciness for each sample, which were considered to be representative of the entire steak. This final step provided for continuous training and maintenance of panelist motivation throughout the testing period.

Consumer Evaluation.

Twenty-seven to twenty-nine different consumers judged each of the six sets of four marbling levels, ranked the four steaks within each set according to preference, and answered specific questions relating to their preferences, making a total of 170 consumer judgements. These same consumers, plus an additional 28, making 198 consumers in all, also answered a series of questions about their shopping habits and preferences, and their knowledge and understanding of beef inspection and grading.

which did not relate specifically to the viewing of the sample steaks.

Handling of the steaks. In preparation for testing, those steaks used to determine consumer preferences were transferred, one set at a time, to a home style upright electric freezer where they were held at -18°C . for 26 hours. Subsequently they were transferred to a home style electric refrigerator and allowed to thaw at 4°C . for 24 hours. When removed, these large steaks were still slightly frozen, to facilitate cutting them into two individual steaks, each approximately 2.5 cm. thick. Cutting the steaks at this time insured that any colour changes in the two subsequent sets would be identical. In this way, there were virtually no differences in the two sets of steaks, thus enabling two consumer interviews to be conducted at the same time. After separation, the steaks were cleaned of any saw residue, and were trimmed if necessary to an average fat cover thickness of 1 cm. Subsequently, they were placed on styrofoam trays, with the freshly cut surface upward, and were wrapped in oxygen permeable film and heat sealed.^a All steaks were coded with a four digit number.

The wrapped steaks were transferred in styrofoam cold chests to the site of consumer evaluation. For purposes of display, each set of four was randomly arranged on a plastic tray. The respondents were not shown the samples until they were ready to answer specific questions about them.

Consumer questionnaire. To aid development and preparation of a structured consumer questionnaire, three groups of women were asked to discuss in group interview situations, their meat shopping habits and criteria for judging quality in beef. This method of marketing research,

^a Steak preparation courtesy of Fort Richmond Tom Boy Store.

referred to by Hansen (1964) as "Group Dynamics", was particularly suitable as a preliminary step in this study, because each participant in the group helped to draw out reactions from every other person present. Thus, there was considerable interaction which did much to stimulate thought and bring out ideas and comments about meat shopping preferences which otherwise might not have been forthcoming. In addition, this approach allowed for the determination of the relative importance of the various concepts brought forth by the consumers, and thus made it possible to give them appropriate weight in the structured survey. This method does not, however, yield results suitable for statistical analysis.

Three group interviews, composed of five to six women per group, were conducted in order to make these preliminary assessments. All interviews were conducted in a private home. To provide incentive for cooperation, the respondents were aware that they would receive three dollars for participating. To avoid bias in the design of the questionnaire, certain age and occupation restrictions were placed on the three groups. One group consisted of young women under 30 years of age, another of women between the ages of 35 and 50, and a third of women 50 years of age and over. All respondents were experienced meat shoppers, were not home economists, and had no household members connected with the meat industry.

The group moderator used no formal questionnaire, but followed a flexible outline which directed the participants to discuss the following areas: their meat shopping habits and preferences, the factors affecting their meat purchases, the importance of price in making a purchase, the participation of their husbands in the meat buying process, their methods of visually judging beef quality, and their overall satisfaction with

beef purchases, including the factors important in judging quality of cooked beef. Each interview lasted approximately 1 to 1½ hours and was recorded in total on tape. The results were summarized and used to develop a preliminary questionnaire. Following a pretest of the questionnaire, consisting of 12 sample interviews with individual consumers, minor revisions were deemed necessary.

The final questionnaire (Appendix B) was divided into six main parts as follows:

1. Description of personal characteristics, included in questions 1 to 6 inclusive.
2. Description of meat shopping and serving preferences, included in questions 7 to 12 inclusive.
3. Consumer criteria for judging quality in raw and cooked beef steak, included in questions 13 to 18 inclusive.
4. Consumer knowledge and understanding of beef inspection and grading, included in questions 19 and 20.
5. Consumer preferences for sample steaks, and reasons for such, included in questions 21 to 32 inclusive.
6. Consumer satisfaction with steak quality and package label information, included in questions 34 to 35 inclusive.

Consumer surveys. All consumer surveys were conducted in the facilities of Opinion Place located on the air conditioned mall of the Polo Park Shopping Center. Thus respondents were only those who came to Polo Park. A traffic study conducted by Reid (1971) indicated that when Polo Park customers were compared to the population of Metropolitan Winnipeg as a whole, there was a slightly higher proportion of people

over 40, of females and of married people. Generally however, the shoppers represented an almost perfect cross section of the population of Winnipeg by sex and age. The people who shop at Polo Park tend to be more affluent than the population of Winnipeg as a whole, with 45 percent having household incomes of \$10,000. or more. In addition Polo Park shoppers seem to be better educated than the population as a whole with less than 10 percent not completing high school.

All interviews were conducted by two interviewers, within a ten day period in the summer of 1972. A training period was provided for, within the actual situation in conjunction with the pretest of the questionnaire.

In total, 198 consumers were interviewed, 93 percent (184) of which were women, and 7 percent (14) of which were men. A representative sample of women in Metropolitan Winnipeg was followed, as outlined in Table 9. In view of the relatively small number of men interviewed, no attempt was made to make this part of the sample representative. Between 27 and 29 consumers were interviewed on each of seven days, with one of the six sets of four sample steaks being viewed each day. Each interview took from 12 to 20 minutes, depending upon the interviewee, although most were about 15 minutes in length.

Consumers were approached at random, and were told that this was a survey on meat shopping habits being conducted by a graduate student at the University of Manitoba. They were asked if they would cooperate by responding to a questionnaire. Those who were willing to participate were asked a series of questions to ensure that they met the following specifications:

1. The respondent did most of the meat shopping for the household,

Table 9

Representative Sample of Women in Metropolitan Winnipeg

Occupational Classification & Age Group	Married ^a (No.)	Single (No.)
<u>Not employed</u> ^b		
18-24 years	6	6
25-34	18	3
35-44	20	2
45-54	17	2
55 +	38	4
<u>Blue collar</u> ^c		
18-24 years	3	3
25-34	4	1
35-44	6	1
45-54	6	1
55 +	5	1
<u>White collar</u> ^d		
18-24 years	8	8
25-34	7	1
35-44	8	1
45-54	7	1
55 +	4	0

(Excerpt from Murray, 1971)

^a Includes widowed and divorced.

^b All people not holding a permanent or part-time job, so not having an employer. Includes housewives.

^c Includes workers classified as skilled laborers and unskilled laborers as illustrated in Appendix C.

^d Includes workers classified as professional people, business executives, salespeople and clerical workers as illustrated in Appendix C.

either alone or with some other person.

2. Neither the respondent nor members of their household could be employed in the meat industry, or could be a home economist.

3. The respondent had to be currently using steak at least once per month.

These restrictions, and those of a representative sample of women (Table 9), resulted in a sample of steak users that consisted of a considerable number of respondents 55 years of age or older. No attempt was made to make the sample representative according to income or education levels. However, steak users could be expected to be of higher income levels, and possibly of higher education levels. Work by Rhodes et al. (1955) and by Lasley et al. (1955) showed that consumer preferences for grades of steaks and roasts showed little if any relationship to income or education levels.

After obtaining the preliminary information, the interviewers checked the quota sheet before continuing, to avoid oversampling of a particular group. The sample of respondents obtained is described in Table 10, which illustrates the distribution of the participants by occupation, marital status and age. The number of participants in each age group were as follows: 15 percent (29) under 25 years of age; 18 percent (35) between 25 and 34 years of age; 21 percent (41) between 35 and 44 years of age; 20 percent (39) between 45 and 54 years of age; and 27 percent (54) were 55 years of age or older. Fifty-three percent (105) of the respondents were not employed outside the home, the majority of these being full time homemakers. Of those who were employed outside the home, 39 percent (36) were blue collar workers, and 61 percent (57) were white collar workers.

Table 10

Characterisation of Respondents

Occupational Classification & Age Group	Married		Single	
	Number	Percent ^a	Number	Percent ^a
Not employed				
18-24 years	6	3.0	2	1.0
25-34 years	18	9.1	-	-
35-44 years	20	10.1	-	-
45-54 years	18	9.1	1	0.5
55 and over	39	19.7	2	1.0
Blue collar				
18-24 years	3	1.5	2	1.0
25-34 years	4	2.0	2	1.0
35-44 years	9	4.6	1	0.5
45-54 years	9	4.6	-	-
55 and over	6	3.0	1	0.5
White collar				
18-24 years	8	4.0	8	4.0
25-34 years	9	4.6	2	1.0
35-44 years	10	5.1	1	0.5
45-54 years	10	5.1	1	0.5
55 and over	6	3.0	-	-
Total	175	88.5	23	11.5

^a All percents are of 198 respondents.

The sample was limited by the fact that it was not possible within the time period to fill the following quotas:

Single	No. of people required
not employed	
18-24 years	4
25-34	3
35-44	2
45-54	1
55 +	2
blue collar	
18-24 years	1

The reason for this may have been that since they were such small groups it would have been most difficult to confront them in the mall. But perhaps even more important is the fact that these people, in particular the single unemployed, would not be expected to be the meat shoppers for their households. However, they were part of the representative sample of women, and thus some attempt to sample them had to be made.

RESULTS AND DISCUSSION

Laboratory Results

Objective tests on raw steaks.

1. Proximate analysis.

The percent ether extract on a wet basis was found to be significantly related to marbling level (Table 11). As marbling level increased, the percent ether extract increased, as evidenced by the mean percent ether extract of the respective marbling levels which were 1.49, 2.80, 4.68 and 6.40 percent. In addition the differences between each of the marbling levels were significant ($p < 0.05$). These data then give further credence to the marbling level scale which was established on a visual basis. There were real differences in the amount of intramuscular fat among the four marbling levels, and these differences were in the expected direction.

Neither the percentage moisture content, nor the percentage protein were found to be related to the marbling level (Table 11). The average moisture content per steak was 72.81 percent and the average protein content was 23.49 percent (wet basis).

2. Rib eye area.

The rib eye area was not found to be related to marbling level (Table 11). Thus, any consumer preferences for a particular marbling level were not related to the rib eye area. Average rib eye areas for the respective marbling levels were 122.74, 115.13, 105.26 and 109.84 sq. cm.

Table 11

Analysis of Variance Data for the Objective
Tests on Raw Steaks

Source of Variation	Degrees of Freedom	Mean Squares for Objective Measurements			
		% Ether Extract	% Water	% Protein	Rib eye area
Total	23	1.86	2.15	1.02	1.37
Among Marbling Levels (M)	3	12.85**	6.02	2.43	3.61
Among Sets (S)	5	0.13	0.53	1.10	0.47
Error (M x S)	15	0.24	1.91	0.78	1.22

** Significant at $P < 0.01$.

Objective tests on cooked steaks.

1. Percent cooking losses.

There were no significant differences in the percent cooking losses among the four marbling levels or between grades. The average cooking loss among the twenty-four steaks was 27.7 percent.

2. Shear force and relative fluid holding capacity.

There were no significant differences among marbling levels in the shear force measurements made on broiled steaks. However, the variability between grades was much greater than the variability among the three marbling levels within the A grade. Significant differences were apparent between grades A and B in the relative fluid holding capacity, but not among the three marbling levels within the A grade (Table 12). Mean scores for these physical measurements show that B grade steaks tended to be firmer and were less juicy than A grade steaks (Table 13).

Table 12
Analysis of Variance Data for the Physical
Tests on Broiled Steaks

Source of Variation	Degrees of Freedom	Mean Squares for Physical Characteristics Tested	
		Force to Shear	Water Holding Capacity
Total	23	0.76	0.00007
Among Marbling Levels (M)	3	0.92	0.0012
Between Grades A & B	1	2.23	0.0032*
Among Grade A Marbling Levels	2	0.26	0.00015
Among Sets (S)	5	1.25	0.0009
Error (M x S)	15	0.56	0.0005

Sensory tests on cooked steaks. Significant differences among the four marbling levels were apparent for two of the three characteristics judged by the sensory panel -- firmness and juiciness (Table 14). Differences in chewiness were not significant. The differences in firmness and juiciness were apparently due to grade rather than marbling level. Partitioning the sources of variability for marbling level showed significant differences between Grades A and B, but no differences among the three marbling levels within the A grade, both for firmness and juiciness. Mean scores for sensory evaluation (Table 13) show that Grade A steaks were softer and juicier than Grade B steaks and tended to be less chewy. These data substantiate the trends of the physical measurements of shear force and relative fluid holding capacity.

Table 13

Mean Scores for Laboratory Tests on Broiled Steaks

Characteristic Measured	Marbling Levels				Grade	
	1	2	3	4	A	B
<u>Sensory Tests^a</u>						
Firmness (max = 7)	3.68	3.08	3.14	3.15	3.12	3.68
Chewiness (no. of chews)	15.06	14.25	13.42	13.95	13.87	15.06
Juiciness (max = 7)	4.67	4.76	4.97	5.11	4.94	4.67
<u>Physical Tests</u>						
Force to shear (lbs.) ^b	7.26	6.32	6.71	6.64	6.56	7.26
Water holding capacity ^c (Max = 1)	0.70	0.73	0.73	0.72	0.73	0.70

^a 36 values (6 judges x 6 sets) contributed to each mean score for each marbling level; that is 108 values for Grade A, and 36 for Grade B.

^b 54 values (3 reading x 3 cores x 6 sets) contributed to each mean score for each marbling level; that is 162 values for Grade A, and 54 for Grade B.

^c 24 values (4 readings x 6 sets) contributed to each mean score for each marbling level; that is 72 values for Grade A, and 24 for Grade B.

Table 14

Analysis of Variance Data for Sensory
Evaluation of Broiled Steaks

Source of Variation	Degrees of Freedom	Mean Squares for Sensory Characteristics Tested		
		Firmness	Chewiness	Juiciness
Total	143			
Among Marbling Levels (M)	3	2.81**	16.91	1.45*
Between Grades A & B	1	6.75**	7.93	2.15*
Among Grade A Marbling Levels	2	0.84	0.63	1.10
Among judges (J)	5	1.78*	52.13**	0.68
Among sets (S)	5	11.25**	17.98	2.38**
M x J	15	0.40	4.93	0.14
Error	115	0.69	10.08	0.52

*,** Differences significant at $P < 0.05$ and $P < 0.01$, respectively.

Correlations. Sensory firmness and force-to-shear were significantly correlated (Table 15). It would appear then that these two parameters measure the same directional differences of the same texture characteristic. However, the sensory panel measurement of firmness is a more sensitive indicator of beef tenderness than is the Warner-Bratzler measurement of force-to-shear. In spite of the time and cost factors then, it appears that sensory panels are essential to the study of beef tenderness if accurate judgments of tenderness are to be obtained.

Sensory firmness and sensory chewiness were significantly correlated (Table 15), and thus it appears that they are measuring essentially the same sensory attribute. This correlation may have been

strengthened to some extent by the methods used for sensory evaluation, in that all three parameters for each sample were judged at the same time. However, sensory firmness appeared to be somewhat more sensitive, in that it showed significant differences between marbling levels. Chewiness, however, has an advantage in that it is a simpler measurement to use, requiring no anchored scales and a minimum of training. As would be expected, sensory chewiness correlated significantly with force-to-shear (Table 15).

Table 15

Correlation Coefficients from Analysis of Covariance
of Sensory and Objective Measurements

Parameters	Correlation Coefficients
Sensory firmness & force-to-shear	0.65**
Sensory firmness & sensory chewiness	0.73**
Sensory chewiness & force-to-shear	0.55*
Relative fluid holding capacity & sensory juiciness	0.25 ns
Relative fluid holding capacity & % ether extract	0.09 ns
Sensory juiciness & % ether extract	0.09 ns

*,** Significant at $P < 0.05$ and $P < 0.01$ respectively.

ns Not significant.

The measurement of relative fluid holding capacity did not appear to be a useful objective measurement of juiciness (Table 15). It did not show correlation with either sensory juiciness or with percent ether

extract on a wet basis, and sensory juiciness was not significantly correlated with percent ether extract. It would appear that the best method of determining beef juiciness still involves a trained sensory panel.

Consumer Evaluation Results

A detailed description of the 198 survey respondents is outlined in the Methods (p. 42).

Consumer criteria for judging quality of raw and cooked steaks.

When the survey participants were asked what the most important characteristic was that they looked for, when selecting one steak over another of the same type and price, the majority said that the amount of fat, or leanness, was the primary criterion used (Table 16). The colour of lean was second most important, and the amount of bone third. However, a considerable number of people put the emphasis on the dimensional characteristics of the piece of beef, such as size, thickness, and the number of servings it would provide. While only a relatively small number made any specific references to marbling, many of the respondents likely looked for this characteristic, as evidenced by the comments made about the sample steaks later in the survey, but included this criteria in their comments pertaining to the amount of fat, or leanness. A much smaller proportion of consumers were particularly concerned about the colour of fat, the amount of gristle or sinew, or the grain and texture of the meat.

Virtually all of the respondents listed two criteria that they used to make a decision between similar pieces of beef, but fewer were concerned with a third, and the majority did not list a fourth or fifth.

Table 16

Criteria Used by Consumers when Selecting One Steak
Over Another of the Same Type and Price

Criteria \ Rank	Most important (%)	2nd most important (%)	3rd most important (%)	4th most important (%)	5th most important (%)
Colour of lean	22.7	31.3	20.02	10.7	1.5
Amount of fat, leanness	45.5	31.8	9.6	3.0	1.0
Reference to marbling	8.6	4.6	6.1	1.5	0.5
Colour of fat	0.5	3.0	5.1	4.6	1.5
Amount of bone	9.1	17.2	13.1	1.5	1.5
Amount of gristle or sinew	0.5	3.0	2.5	2.0	-
Dimensional character- istics	9.1	7.1	10.6	2.0	-
Reference to grain or texture	2.0	1.0	3.5	3.0	1.0
Other	2.0	0.5	1.5	3.0	0.5
No further answers	-	0.5	27.8	68.7	92.5
Total percent	100	100	100	100	100
Total number of consumer responses	198	198	198	198	198

With regard to the cooked beef product, as was expected, tenderness was by far the most important criteria used to judge the quality of a steak, as illustrated in Table 17. A much smaller number of respondents were concerned primarily about flavour or taste, and juiciness, although

these were found to be the second and third most important criteria used by most people. Eighty-eight percent (174) of the consumers listed at least two criteria they used to judge quality of a cooked steak, but the majority did not elaborate further.

Table 17

Criteria Used by Consumers to Judge
the Quality of a Cooked Steak

Criteria \ Rank	Most important (%)	2nd most important (%)	3rd most important (%)
Tenderness	80.8	12.6	2.0
Flavour and taste	9.1	39.9	5.6
Juiciness	5.6	26.3	23.7
Texture, not stringy, no gristle	3.0	5.1	2.0
Not too fatty or greasy	1.5	1.5	5.1
Appearance of meat, colour	-	1.0	1.0
Amount of shrinkage	-	1.0	-
Other	-	0.5	-
No further answers	-	12.1	60.6
Total percent	100	100	100
Total number of consumer responses	198	198	198

Consumer preferences for sample steaks. When the consumers were presented with a simulated buying situation, and were asked to rank the four experimental steaks according to visual preferences, they made definite

choices within each set. Taking all six sets into consideration, the sums of rank scores assigned by 170 consumers (Table 18), show that generally B grade steaks (that is, marbling level 1 steaks), were selected in preference to A grade steaks (that is, marbling levels 2, 3 and 4 steaks). Within each of the six sets, the respondents demonstrated significant agreement between rankings of the four marbling levels, and significant differences among the four marbling levels were evident in all sets. However, the marbling level preferred varied from one set to another. When the rankings for the three A grade marbling levels were combined and comparisons made between A and B grades, significant differences were evident in 4 out of 6 sets; in all these 4, the B grade was preferred. Significant differences were apparent among the rankings of the three marbling levels within the A grade, but these preferences occurred in no consistent pattern. When all six sets were considered together, that is, the rank sums of 170 respondents, B grade was significantly preferred to A, and no preferences were evident within the three marbling levels of the A grade. That is, B grade meat was selected as the first choice, significantly more often than was A grade meat.

While all of the 170 consumers in the survey stated definite preferences for the four steaks within each set, there were inconsistencies in some of their preferences, in that only 70 percent (119) were willing to attach any measure of economic strength to their preferences (Table 19). The economic strength of preferences refers to the extent to which the preferences among a set of products are a function of their price relationship. Thus 30 percent (51) of the consumers were unwilling to attach any measures of economic strength to their preferences, in that they were unwilling to pay any more for their first choice than for their

Table 18

Consumer Buying Preferences Among Raw Steaks^a

Test Set (27-29 consumers in each set)	Marbling Level ^b				Chi-Square Values	
	1 (B)	2 (A)	3 (A)	4 (A)	Between Grades A & B	Among Marbling Levels of Grade A
I	72	77	83	58	0.0068	6.69
II	41	49	98	82	20.79**	33.56**
III	51	68	93	78	10.29**	33.29**
IV	48	107	47	88	16.51**	38.56**
V	40	64	84	92	25.65**	11.64**
VI	79	89	54	58	0.38	13.79**
Total ^c	331	454	459	456	41.53**	0.61

^a Sum of ranks where the lowest value is the most preferred.

^b In each of the test sets there was significant agreement among consumers and significant differences among samples in rankings.

^c Total number of consumer responses = 170.

*,** Differences in the comparison significant at $P < 0.05$ and $P < 0.01$, respectively.

last choice. Another 4 percent (7) felt that they would be willing to pay more but were unable to estimate how much more they would pay.

Those consumers who chose Grade B steaks as their first choice, tended to be more willing to pay a higher price for their choice than were those who chose Grade A steaks (Table 19). While the differences were not statistically significant, 72 percent (52) of those who chose marbling level 1 steaks were willing to pay more, whereas only 57 percent (16), 65 percent (24), and 61 percent (20) were willing to pay more for marbling levels 2, 3 and 4 steaks respectively. Those consumers who were not willing to pay any more for their choice, gave a variety of reasons for their attitude. The most important were that meat was already too expensive, that all the steaks were the same cut and should therefore be the same price, and that there were not enough differences among the steaks (Table 20). Only one person in the entire survey freely admitted that she was unable to determine the eating quality of a steak by looking at it.

When the respondents were asked to explain why they had chosen a particular steak as their first choice, the amount of fat within the meat, or marbling, was the most important criteria for making their choice (Table 21). It would appear, then, that more consumers preferred those steaks with a minimum of marbling -- thus their preference for Grade B steaks. However as marbling levels increased, consumers did not discriminate between levels -- preferences for Grade A steaks occurred in no consistent pattern.

Although the steaks were chosen for the experiment to be similar in colour, and were trimmed of exterior fat to approximately the same thickness, the criteria of colour of lean and amount of outside fat were

cited by the respondents as being the next most important reasons for making their choices. A considerable number also mentioned dimensional characteristics such as size and thickness, or the amount of tenderloin etc., even though the steaks were essentially alike with regard to these characteristics and were therefore judged to be virtually identical. For the purpose of further analysis this reason was eliminated, since when mentioned, the respondents were asked to disregard such factors.

Table 19

The Economic Strengths of Consumer Preferences
Among Marbling Levels^a

Amount more/pound		First Choice Marbling Level				Total
		1	2	3	4	
None at all	(No.)	16	12	12	11	51
	(%)	22.2	42.9	32.4	33.3	30.0
Unable to estimate	(No.)	4	-	1	2	7
	(%)	5.6	-	2.7	6.1	4.1
≤10¢/lb.	(No.)	28	9	15	9	61
	(%)	38.9	32.1	40.5	27.3	35.9
11-20¢/lb.	(No.)	16	5	7	8	36
	(%)	22.2	17.9	18.9	24.2	21.2
>20¢/lb.	(No.)	8	2	2	3	15
	(%)	11	7.1	5.5	9.1	8.8
Total percent		100	100	100	100	100
Total number of consumer responses		72	28	37	33	170

^a Actual $\chi^2 = 7.81$, $P < 0.05$ with 12 df. (Theoretical $\chi^2 = 21.02$).

Table 20

Reasons for Consumer Reluctance to Attach
Economic Strength to Their Preferences

Reasons	Percentage of Respondents
Meat is already too expensive	27.5
All steaks same cut, therefore should be same price	23.5
All should be same quality, freshness	9.8
There is always some variation - even with steaks from the same animal	3.9
There is not enough difference between steaks	23.5
Everyone has their own preference - next person might choose my 4th choice as his 1st choice	7.8
Unable to determine eating quality by looking at the steaks	2.0
Consistently receive good quality where shop	2.0
Total percent	100
Total number of consumer responses ^a	51

^a Question was asked only of those consumers who were unwilling to pay more for the steak of their choice. Consequently the number of respondents was 51.

Table 21

Criteria Used by Consumers to Determine
Visual Preferences

Criteria	Rank	Most important (%)	2nd most important (%)
Amount of exterior fat		18.2	12.3
Amount of marbling		30.5	23.4
Colour of lean		24.6	26.5
Colour of fat		1.2	1.8
Amount of bone		7.1	15.3
Characteristics of the bone		1.2	0.6
Texture of lean		2.9	2.4
Stamp on the meat		1.2	1.2
Dimension characteristics		11.2	15.3
Other		1.8	1.2
Total percent		100	100
Total number of consumer responses		170	170

When the second most important reasons for making a choice were considered, the colour of lean and amount of marbling were still of prime importance, but the amount of bone became more important as a second reason than as a first reason (Table 21). The colour of fat, characteristics of the bone, texture of the lean, stamp on the meat or other reasons were of relatively no importance, either as a first or second reason.

Although those people who preferred grade B steaks tended to pay more attention to the external fat cover and less attention to the amount of marbling, than those who preferred grade A steaks, there were no statistically significant differences among the reasons given for choosing either grade (Table 22). Almost equal attention was paid by both groups to the colour of lean, and the amount of bone. It would appear then, that while consumers do have definite preferences, their reasons for the same preference may vary considerably. That is, different characteristics of a steak are important to different people.

Of those people who considered the amount of marbling in the meat when choosing a steak, the majority preferred the amount of marbling to be either "as little as possible", "not too much", or "a slight amount only", as can be seen from Table 23. Only 31 percent (38) liked "a medium amount", "a fair amount", or "well marbled steaks". Those who liked a lesser amount, tended to associate marbling incorrectly with negative characteristics of the meat. They looked upon it as waste, being undesirable, and associated it with gristle, and toughness and greasiness of the cooked product. Those who liked a greater amount of marbling associated it correctly with positive characteristics of the meat, and a better grade or quality of meat. They felt it would make the meat more

tender, moister or juicier, and more flavourful. As can be seen in Table 24, the ability of the respondents to match their preferences regarding the amount of marbling to their choice of marbling level was statistically significant at a high level of probability ($P < 0.01$); that is those who liked a lesser amount of marbling chose steaks of marbling levels 1 and 2, while those who preferred a greater amount of marbling chose steaks of marbling levels 3 and 4. Consumers, then, are able to determine the extent to which the characteristic of marbling is present, but because marbling means different things to different consumers, their preferences regarding the amount of marbling are not the same.

Table 22

The Relationship^a Between the Grade of Steak Preferred and the Criteria Used by Consumers to Establish Visual Preferences

Grade Choice	Reason	Amount of external fat	Amount of marbling	Colour of lean	Amount of bone	Other	Total
A	Number	17	35	28	8	10	98
	Proportion ^b	0.17	0.36	0.29	0.08	0.10	1.00
B	Number	19	24	21	4	4	72
	Proportion	0.26	0.33	0.29	0.06	0.06	1.00
Total	Number	36	59	49	12	14	170
	Proportion	0.43	0.69	0.58	0.14	0.16	2.00

^a Actual $\chi^2 = 3.16$, $P > 0.05$ with 4 df. (Theoretical $\chi^2 = 9.49$).

^b Proportions are of those consumers choosing a particular grade.

Table 23

The Relationship Between the Amount of Marbling Preferred by Consumers and What Marbling Indicates to Them

Amount Preferred of marbling	As little as possible (%)	Don't like too much (%)	Slight amount, not too much (%)	Medium amount of thin streaks (%)	Fair amount, well marbled (%)	Total (%)
Moister meat, juicier	12.1	20.8	32.1	-	20.0	18.7
More tender meat	-	-	32.1	33.3	53.3	22.0
Waste, undesirable	51.5	16.6	-	-	-	17.1
More flavourful meat	-	12.5	10.7	33.3	-	6.5
Better quality, better grade	-	4.2	10.7	-	-	5.7
Associate with gristle, toughness	27.3	37.5	3.7	-	-	15.4
More tender, juicy & flavourful	-	4.2	10.7	33.3	26.7	11.4
Greasy meat	9.1	-	-	-	-	2.4
Nothing, don't know	-	4.2	-	-	-	0.8
Total percent	100	100	100	100	100	100
Total number of consumer responses ^a	33	24	28	3	15	123

^a Total number of consumers mentioning marbling = 123 or 73.0 percent of the 170 sampled.

Table 24

The Relationship^a Between the Amount of Marbling Desired by Consumers and the Marbling Level of Their Most Preferred Sample Steak

Amount of Marbling level	As little as possible	Not too much	Slight amount but not too much	Medium amount	Fair amount, well marbled	No mention made of marbling
(No.)	31	7	8	2	-	27
1						
(%)	94.0	29.2	28.6	8.7	-	49.1
2						
(No.)	1	6	11	5	1	5
(%)	3.0	25.0	39.3	21.7	6.7	9.1
3						
(No.)	1	8	4	10	4	11
(%)	3.0	33.3	14.3	43.5	26.7	20.0
4						
(No.)	-	3	5	6	10	12
(%)	-	12.5	17.8	26.1	66.6	21.8
Total number of consumer responses ^b	33	24	28	23	15	55
Total percent	100	100	100	100	100	100

^a Actual $\chi^2 = 87.30$, $P < 0.01$ with 12 df. (Theoretical $\chi^2 = 26.22$).

^b Total number of consumers mentioning marbling = 123 or 73 percent of the 170 sampled.

Table 25

The Relationship Between the Amount of External Fat Preferred
by Consumers and What External Fat Indicates to Them

Indication of external fat	Amount Preferred	As little as possible (%)	Not too much - well trimmed (%)	Slight amount, not too much (%)	Fair amount (%)	Total (%)
Moister meat, juicier	-	-	4.9	8.7	22.2	7.0
More tender meat	-	-	4.9	-	22.2	5.3
More tender, juicy and flavourful	-	-	4.9	13.0	16.7	7.0
Necessary for cooking purposes	-	-	17.1	13.0	11.1	10.5
Animal was properly fed	-	-	2.4	-	-	0.9
More flavourful meat	-	-	14.6	52.2	11.1	17.5
Waste, undesirable	96.9	51.2	8.7	11.1	49.2	
Nothing, don't know	3.1	-	4.4	5.6	2.6	
Total percent	100	100	100	100	100	
Total number of consumer responses ^a	32	41	23	18	114	

^a Total number of consumers mentioning amount of external fat = 114 or 67.2 percent of the 170 sampled.

Of those people who considered the amount of external fat in making their choice, the majority preferred "as little as possible", or "not too much - well trimmed" (Table 25). These respondents associated external fat with waste, and as such felt it to be largely undesirable. However, contrary to existing evidence (Cover et al., 1956; Larmond et al., 1968)

those who liked a greater amount of external fat felt that it enhanced the quality of the meat, making it moister, more flavourful and more tender. They felt it was necessary for cooking purposes.

The colour of fat was not important to most of the respondents as a determinant of their choice, but of those who did take it into consideration, 15 percent of the sample, the large majority specified a preference for "white fat", or a "light coloured fat" (Table 26). They felt that white fat was an indication of freshness of the meat, that the meat was from a young animal, or that it was good quality beef. The two respondents who preferred "creamy fat -- not too white", felt that this indicated proper aging of the meat. The large majority of respondents expressed a negative attitude toward yellow or brownish yellow fat, as evidenced by Table 27. This indicated to them that either the animal or the meat was old, or that the meat would surely have an undesirable taste and smell, or be of poor quality, or tough. Two people thought yellow fat to indicate that the meat had been frozen at some time.

The colour of lean was a very important determinant of consumer choice among the four steaks. A substantial majority indicated a preference for either a "red, nice red", a "bright red", or a "good red, natural red" (Table 28). Most of these consumers associated such a colour with freshness, or freshly cut meat, rather than with characteristics of the meat itself such as tenderness and juiciness. Those who stated a preference for "medium red" or "pinkish red" also associated it with freshness of the meat, but some felt that such a colour was indicative of proper aging of the meat. Those who preferred a "dark" or "deep red" also used colour to indicate proper aging, as well as to indicate tenderness of the meat. Consumers had definite ideas about the colour of

lean they avoid when shopping. The majority had a dislike for a "dark colour", or "brownish or blackish" colour, as they felt that it was indicative of "old meat", or meat that had "not been freshly cut" (Table 29). A considerable number also felt that meat of such a colour was spoiling, or had already spoiled. A "greyish" or "greenish brown" colour was thought to be a most undesirable colour by a considerable number of consumers who felt that this too was indicative of old or spoiled meat.

Table 26

The Relationship Between the Colour of Fat Preferred
by Consumers and What That Colour Indicates to Them

Indication of colour \ Colour Preferred	White (%)	Light colour (%)	Creamy - not too white (%)	Total (%)
Fresh meat, freshness	52.1	100.0	-	51.9
Good quality meat	17.4	-	-	14.8
Meat from a young animal	21.7	-	-	18.5
Properly aged meat	-	-	100.0	7.4
Not properly aged meat	4.4	-	-	3.7
Other	4.4	-	-	3.7
Total percent	100	100	100	100
Total number of consumer responses ^a	23	2	2	27

^a Total number of consumers mentioning colour of fat = 26 or 15.3 percent of the 170 sampled.

Table 27

The Relationship Between the Colour of Fat Avoided by
Consumers and What That Colour Indicates to Them

Indication of colour	Colour avoided	Yellow - yellowish (%)	Brownish yellow (%)	Too white - very white (%)	Total (%)
Old meat, not fresh		25.0	25.0	-	23.1
Undesirable taste & smell		15.0	-	-	11.5
Dried-out meat		-	25.0	50.0	7.7
Tough meat		5.0	-	-	3.8
Poor quality meat		10.0	-	-	7.7
Previously frozen meat		10.0	-	50.0	11.5
Meat from an old animal		30.0	50.0	-	30.9
Other		5.0	-	-	3.8
Total percent		100	100	100	100
Total number of consumer responses ^a		20	4	2	26

^a Total number of consumers mentioning colour of fat = 26 or 15.3 percent of the 170 sampled.

Table 28

The Relationship Between the Colour of Lean Preferred by Consumers
and What that Colour Indicates to Them

Indication of colour	Colour		Good					Light			Total (%)
	Preferred	Red, nice red (%)	Bright red (%)	Good red, natural (%)	Dark red, deep red (%)	Medium red (%)	Pinkish red (%)	Reddish brown (%)	Other (%)		
Fresh meat, freshness		73.9	71.4	71.4	12.5	61.1	66.6	100.0	50.0	100.0	64.8
Freshly cut meat		-	10.7	14.3	6.3	5.6	16.7	-	-	-	6.3
Juicier, more tasty meat		2.2	-	-	6.3	-	-	-	-	-	1.4
More tender meat		-	3.6	-	18.7	-	-	-	-	-	2.8
Meat from a young animal		2.2	3.6	-	6.3	-	16.7	-	-	-	2.8
Better quality meat, better grade		8.8	-	4.8	6.3	5.6	-	-	-	-	5.0
Properly aged meat		4.3	7.1	-	37.5	22.2	-	-	50.0	-	10.5
Just a preference		4.3	3.6	-	-	5.6	-	-	-	-	2.8
Other		4.3	-	9.5	6.3	-	-	-	-	-	3.5
<hr/>											
Total percent	100	100	100	100	100	100	100	100	100	100	100
Total number of consumer responses ^a	46	28	21	16	18	6	2	2	3	142	

^a Total number of consumers mentioning colour of lean = 142 or 83.5 percent of the 170 sampled.

Table 29

The Relationship Between the Colour of Lean Avoided by Consumers
and What that Colour Indicates to Them

Colour preferred Indication of colour	Brownish or blackish (%)	Dark colour (%)	Dark red, Blueish (%)	Too light (%)	Too bright (%)	Greyish- brown (%)	Greenish- brown (%)	Any discolo- ration (%)	Too light or dark (%)	Total (%)
Old meat, not fresh	73.3	64.4	75.0	33.3	16.7	75.0	40.0	66.7	27.3	60.6
Not freshly cut meat	6.7	6.7	-	-	16.7	-	-	16.7	-	6.0
Tough meat	-	-	-	16.7	16.7	-	-	-	-	1.4
Dry meat	-	2.2	-	-	-	-	-	-	-	0.7
Poor quality meat	-	-	12.5	-	-	5.0	10.0	-	-	2.1
Not properly aged meat	-	2.2	-	33.3	33.3	-	-	-	9.1	4.2
Spoiled meat	13.4	6.7	-	-	-	15.0	50.0	16.7	9.1	12.0
Meat from an old animal	3.3	8.9	12.5	-	-	-	-	-	9.1	5.0
Other	3.3	8.9	-	16.7	16.7	5.0	-	-	45.5	9.2
Total percent	100	100	100	100	100	100	100	100	100	100
Total number of consumer responses ^a	30	45	8	6	6	20	10	6	14	142

^a Total number of consumers mentioning colour of lean = 142 or 83.5 percent of the 170 sampled.

Although texture or grain of the meat was not used as a determinant of choice by many consumers, it was used by some, primarily as an indicator of eating qualities of the beef. Generally, a "fine grained" raw steak was thought to have the best chances of being tender and juicy when cooked. On the other hand a "coarse grain" or "stringy texture" was indicative of a tough steak. A "fibrous texture" indicated that the steak could be expected to be tough and stringy. Of the total sample only 15 consumers, or 9 percent, used texture as a clue in picking their first choice steak.

The characteristics of the bone were important to only 11 respondents (6 percent), but the general feeling was that a "light coloured" bone meant that the meat was from a young animal, or that the meat had been freshly cut. A "dark or brownish" bone indicated the opposite. Other consumers described undesirable bone characteristics as "heavy", "rough" or "dried out" -- these also were indicative of meat from an older animal.

Consumer knowledge and understanding of beef inspection and grading. Generally, the respondents had a better knowledge of inspection than of grading. Ninety-six percent (190) believed that the beef they bought had been inspected. Only one person reported that she believed it was not inspected, and seven people did not know. A smaller number of respondents, 85 percent (168) thought that the beef they bought was graded, and 12 percent (23) did not know. The majority of those who felt that beef was inspected made specific references to wholesomeness when asked what inspection meant to them (Table 30). Another 18 percent (34) made non-specific references to wholesomeness, and 27 percent (51)

related inspection to quality, as it is defined by the grading system. However, only 9 percent (17) believed inspection to in fact mean grading. Seven percent (14) either gave replies that were completely incorrect, or they did not know what inspection meant, or they felt that it meant nothing at all. Fewer consumers were as well informed about grading as they were about inspection, as can be seen by comparing Table 30 to Table 31. Only 32 percent (53) of those who believed their beef had been graded, specifically related grading to quality, as it is defined by the grading system. However, more than 50 percent (85) replied with a non-specific reference to quality, and very few thought that grading implied wholesomeness of the product. Sixteen percent (27) either gave replies that were totally incorrect, or they didn't know what grading meant, or they felt that it meant nothing at all. Only 7 percent (14) answered in a similar fashion when asked about inspection.

The majority of respondents who believed that their beef was inspected and graded, referred to a stamp or label as their means of determining that these functions had been performed, as can be seen in Tables 32 and 33. However, most of these respondents were vague about the nature of the stamp. Nine percent (18) of the respondents referred to the inspection stamp as being a Red or Blue stamp, and thus seemed to be confusing it with the grade stamp. Only one percent (2) gave a more accurate description of the round purple inspection stamp. With regards to the grade stamp, only 7 percent (12) referred to a Red or Blue Stamp, and only 2 percent (4) knew that the grade name was in fact stamped on the meat. A larger percentage of respondents indicated that they relied on the reputation of the store or butcher as assurance that inspection had taken place, than that grading had taken place. Con-

Table 30

Meaning of Meat Inspection to Consumers

Meaning	Percentage of respondents
Specific references to wholesomeness	48.0
Safe to eat, assures wholesomeness	13.7
Meat came from healthy animal	7.4
Meat is fresh, not spoiled	5.8
Meat is produced under sanitary conditions	3.2
Meat is clean, disease free	17.9
Non-specific references to wholesomeness	17.9
Meat satisfies certain standards	3.7
Meat has been properly handled, stored	2.1
Inspection has been performed	7.9
Other non-specific references	4.2
Quality References	26.9
Meat is what it is supposed to be	2.6
Inspection means quality	11.6
Inspection means grading	9.0
Other quality references	3.7
Meat has been stamped	1.6
Other mentions	1.6
Don't know, doesn't mean anything	4.0
Total percent	100
Total number of consumer responses ^a	190

^a Question was asked only of those consumers who thought their beef had been inspected. Consequently the number of respondents was 190.

Table 31

Meaning of Beef Grading to Consumers

Meaning	Percentage of respondents
Specific references to quality	31.6
Amount of fat	16.7
Age or type of animal	8.3
Tenderness or flavour	4.2
Conformation: proportion of waste	2.4
Non-specific references to quality	50.5
Assures quality	33.8
Determines range of quality	8.9
Mention of grade names	6.6
Top animal, top grade of beef	1.2
References to wholesomeness	1.8
Price differentials	5.4
Different types of cuts	0.6
Don't know, doesn't mean anything	10.1
Total percent	100
Total number of consumer responses ^a	168

^a Question was asked only of those consumers who thought their beef had been graded. Consequently the number of respondents was 168.

Table 32

Determinants of Inspection

Determinant	Percentage of respondents
Stamp or label	66.0
Stamp, stamp on meat	42.1
Government stamp or seal	3.7
Red or Blue stamp	9.5
Round, Purple stamp	1.1
Stamp on package	1.1
Label, other stamp mentions	5.3
Tag	3.2
Reputation of store or butcher	11.6
Own ability to tell	2.1
Sign in the store	2.1
Advertising	2.5
Assume	8.4
Other mentions	1.1
Don't know	6.3
Total percent	100
Total number of consumer responses ^a	190

^a Question was asked only of those consumers who thought their beef had been inspected. Consequently the number of respondents was 190.

Table 33

Determinants of Grading

Determinant	Percentage of respondents
Stamp or label mentions	67.2
Stamp on meat or fat	48.8
Blue or Red stamp	7.1
Grade name on stamp	2.4
Mark on meat	2.4
Label or labelled	3.0
Other stamp mentions	3.6
Own ability to tell	7.2
Price of cut	4.2
Quality of cut	1.2
Other ability mentions	1.8
Reputation of store or butcher	4.8
Assume	1.8
Advertising or sign in store	7.1
Other mentions	1.2
Don't know	10.7
Total percent	100
Total number of consumer responses ^a	168

^a Question was asked only of those consumers who thought their beef had been graded. Consequently the number of respondents was 168.

versely, the respondents tended to refer somewhat more often to their own ability to determine that grading had been performed than they did when mentioning determinants of inspection.

Consumers appeared to be fairly knowledgeable about who conducts the inspection and grading of beef -- more so about inspection than grading, as can be seen from Tables 34 and 35. More respondents thought inspection to be carried out by a government agency or government inspector than thought grading to be -- 81 percent (153) as compared to 58 percent (98). A considerably larger number thought that grading was the responsibility of the store or butcher, than thought the same of inspection. Over eight percent (16) of the respondents did not know the source of inspection but twice as many, sixteen percent (27) did not know the source of grading.

Consumer knowledge of the beef grades in use in Canada at the time of the study, was for the most part deficient, as can be seen from Tables 36 and 37. However, the majority of people were able to list two grades used at that time, Red and Blue, and a significant proportion were able to name Red, Blue and Commercial, or Red, Blue "plus a third grade". But a considerable proportion of the people, although they knew beef to be graded, were unable to list any of the beef grades in use at that time, or else they listed incorrect grades such as Number 1, 2, 3 etc. It is interesting to note also, that not one consumer out of the total sample, referred to the grades by their actual names such as Canada Choice, Canada Good, and Canada Standard. In addition, less than half of those consumers who knew beef to be graded, reported Red brand as the top grade. Another 17 percent (29) thought Blue brand to be the top grade, while 4 percent (6) thought Blue and Red brands to be virtually

the same, and both of top grade. Thirty-two percent (54) could not say which grade they thought to be the top grade, or else they replied with completely incorrect answers such as Canada Number 1.

Table 34

The Agency Thought by Consumers
to be in Charge of Inspection

Agency	Percentage of respondents
Government unspecified, or government inspector	74.8
Federal Government	4.2
Provincial Government	1.6
Packer	6.8
Store or butcher	2.6
Other	1.6
Don't know	8.4
Total percent	100
Total number of consumer responses ^a	190

^a Question was asked only of those consumers who thought their beef had been inspected. Consequently the number of respondents was 190.

Table 35

The Agency Thought by Consumers to be
in Charge of Grading

Agency	Percentage of respondents
Government unspecified, or government inspector	54.2
Federal Government	3.0
Provincial Government	1.2
Packer	17.8
Store or butcher	5.4
Other	2.4
Don't know	16.1
Total percent	100
Total number of consumer responses ^a	168

^a Question was asked only of those consumers who thought their beef had been graded. Consequently the number of respondents was 168.

Table 36

Consumers Ability to List Grades Presently^a
in Use in Canada

Grades listed	Percentage of respondents
Could list none	17.8
Red and Blue	45.8
Red, Blue, and Commercial	17.2
Red, Blue, "plus a third grade"	6.6
Number 1, 2, and 3 etc.	2.4
Grade A, B, C etc.	5.4
Red	0.6
Blue	0.6
Other	3.6
Total percent	100
Total number of consumer responses ^b	168

^a i.e. those grades in use prior to September 5th, 1972.

^b Question was asked only of those consumers who thought their beef had been graded. Consequently the number of respondents was 168.

Table 37

The Grade Considered by Consumers to be the "Top" Grade

Top grade	Percentage of respondents
Red	47.0
Blue	17.3
Blue or Red	3.6
Grade A	5.4
Number 1	6.5
Other	2.4
Unable to list any grades	17.8
Total percent	100
Total number of consumer responses ^a	168

^a Question was asked only of those respondents who were able to name at least one beef grade in use at the time of the study, i.e. 138 respondents. However, percents were calculated on the basis of the number of respondents who thought their beef had been graded. Consequently the number of responses included was 168.

Only 47 percent (80) of those who thought beef to be graded, said they took the grade of beef into consideration when shopping (Table 38). Only 44 percent (35) of these same people, or 18 percent of the total sample were in the habit of buying what the grading system defined as the "top" grade of beef, or Red brand (Table 39). Sixteen percent (13) of those who bought by grade bought Blue brand, for the most part thinking it to be the best quality grade, and 22 percent (18) made no

distinction between Red and Blue brand beef. Twenty percent (16) of those who said they bought by grade obviously did not as they said they bought Canada A, or Number 1, for example, neither of which were relevant at the time of the survey.

Table 38

Percentage of Respondents Using the
Beef Grading System

Category	Percentage of respondents
User	47.6
Non-user	52.4
Total percent	100
Total number of consumer responses	198

Table 39

Beef Grades Purchased by Consumers

Grade purchased	Percentage of respondents
Red	42.7
Blue	15.9
Red or Blue	22.0
Top Grade	9.8
Grade A	7.3
Other	2.4
Total percent	100
Total number of consumer responses ^a	82

^a Question was asked only of those consumers who said they considered beef grades when shopping. Consequently the number of respondents was 82.

The tendency to take beef grades into consideration was significantly related ($\chi^2 = 10.32$, $P < 0.05$ with 4 df) to the age of the respondents (Table 40), with the 25-34 age group making the most use of grades as a buying aid. The 24 and under age group made the least use of grades. Occupational classification, as outlined in Appendix C had no relationship whatsoever to the tendency to make use of the grading system.

Table 40

The Relationship^a Between the Use Made of the Beef Grading System and the Age Groups of Consumers

Category	Age Group	24 & under	25-34	35-44	45-54	55 & over
User	(No.)	7	18	11	17	27
	(%)	24.1	51.4	26.8	43.6	50.0
Non-User	(No.)	22	17	30	22	27
	(%)	75.9	48.6	73.2	56.4	50.0
Total number of consumer responses ^b		29	35	41	39	54
Total percent		100	100	100	100	100

^a Actual $\chi^2 = 10.32$, $P < 0.05$ with 4 df. (Theoretical $\chi^2 = 9.49$).

^b Total number of consumer responses included = 198.

Meat shopping and serving preferences of respondents. The majority of respondents, 84 percent (166) did most of their meat shopping themselves, while 14 percent (28) shared the responsibility with their spouse, and 2 percent (4) shared the responsibility with some other person.

Ninety-five percent (188) of respondents chose small cuts of beef on a frequent basis, since only 5 percent (10) bought their meat in large bulk supplies. Sixty-seven percent (133) of the respondents did most of their meat shopping at a large supermarket, while 28 percent (55) bought their meat from a butcher shop, or a small grocery store with a butcher department.

The survey involved only people who served steak in their homes at least once per month, and thus the results allow us to draw a profile of steak users only, and not of the total population. Steak users had definite preferences for meat normally cooked by dry heat methods. This can be seen from Table 41, which illustrates the frequency with which respondents served five particular types of beef, including steak, pot roast, oven roast, stewing beef, and ground beef. Ground beef was the most widely used form of beef, with 45 percent (90) of the respondents serving it two or more times per week, and only 4 percent (8) using it less than once per month. Steak seemed to be the next most popular form of beef. Twenty-one percent (41) of the respondents served it two or more times per week, 38 percent (75) served it about once per week, 24 percent (48) served it two or three times per month, and 17 percent (34) served it about once per month. Oven roast was the third most popular form of beef. While only 4 percent (7) of those interviewed served it two or more times per week, only 11 percent (21) served it less than

once per month. Stewing beef was served more frequently in the homes of the participants than was pot roast.

Table 41

Frequency of Serving Types of Beef in the Home

Frequency \ Type of beef	Steak (%)	Pot roast (%)	Oven roast (%)	Stewing beef (%)	Ground beef (%)
2 or more x per week	20.07	2.0	3.5	1.5	45.5
About 1 x per week	37.9	13.6	44.9	21.7	39.4
2 or 3 x per month	24.2	19.2	25.2	18.2	8.6
About 1 x per month	17.2	18.7	15.7	19.7	2.5
Less than 1 x per month	-	14.7	5.6	15.2	2.5
Not at all in past 12 months	-	31.8	5.1	23.7	1.5
Total percent	100	100	100	100	100
Total number of consumer responses	198	198	198	198	198

All in all, beef was a very popular fare, as compared to pork, veal, poultry, fish, etc. An examination of Table 42, which lists the percentages of home meals involving beef of any kind, shows that almost 90 percent (177) of the respondents used beef in fifty percent or more of the meals where some type of "meat" was served. Seventy-two percent (142) used it at least sixty percent of the time, and 19 percent (38)

used it from ninety to one hundred percent of the time.

Table 42

Percentage of Meals Served in the Home that Involve Beef

Percentage of meals	Percentage of respondents
0 - 29%	3.5
30 - 39%	3.0
40 - 49%	4.0
50 - 59%	17.8
60 - 69%	10.1
70 - 79%	30.3
80 - 89%	12.1
90 - 100%	19.2
Total percent	100
Total number of consumer responses	198

Possibly due to the nature of the sample, which included 54 respondents over fifty-five years of age, the largest number of respondents did the meat shopping for small families. Forty-one percent (81) shopped for no more than two people, while 37 percent (73) shopped for a household of three or four persons. Eighteen percent (35) shopped for five or six persons, and only 5 percent (9) shopped for a household of more than six persons.

The majority of respondents, 39 percent (78) bought prepackaged

meats always, which is probably indicative of a trend towards self-service. Twenty-two percent (43) used a combination of prepackaged meat and butcher services, and 33 percent (66) still relied solely on a butcher for choosing their meat. Six percent (11) of the participants used their own judgement to choose unwrapped meat from behind a butcher counter.

Sirloin steak was the most popular choice of consumers, and round steak was used second most often (Table 43). T-bone steak was a close third choice and the lower-priced chuck steak was next. The remaining choices, including porterhouse, rib, wing, minute steak and others, such as filet mignon, were the first or second choices of only a small number of consumers in the survey. Five percent (10) of the respondents had no real preferences, and utilized all types of steak. These were the same respondents who bought their beef in large bulk supplies. Subsequently, they would have a supply of all the various types of steaks on hand.

The majority of respondents, 76 percent (150), actually cooked the steaks themselves, while 14 percent (28) did not participate in the cooking process. Ten percent (20) shared the responsibility with their spouse. As illustrated in Table 44, the most common method of preparation of the steaks was broiling or barbecuing, depending upon the time of year. Pan-frying and braising were considerably less popular, but were the next most often used methods. Pan-broiling, roasting, stewing, oil fonduing and other methods were seldom used.

Dry heat methods of cooking, such as broiling or pan-frying, contradict the general recommendations for cooking round and chuck steaks which are normally regarded as "less tender" cuts. Most cookbooks, including "Meat--How to Buy--How to Cook" (1968) published by the Canada Department of Agriculture, recommend moist heat methods of cooking, such as braising

to ensure tenderness of round and chuck steaks. The respondents generally broiled or pan-fried the cuts normally regarded as the "more tender" cuts, such as sirloin and porterhouse, whereas the "less tender" cuts were often braised, as can be seen in Table 44. However, it is interesting to note that as many as 48 percent (45) of those consumers who bought round steak as their first or second choice, and up to 80 percent (41) of those who bought chuck steak broiled or pan-fried these with apparent satisfaction, as evidenced by their continued use of these cooking methods. Unfortunately, the respondents were not queried about their use of tenderizers.

Table 43

Types of Steak Bought Most Frequently^a

Type	Most frequent purchase (%)	2nd most frequent purchase (%)	Total ^a (%)
Sirloin	31.3	20.2	25.8
Round	21.3	25.8	23.5
T-bone	19.7	21.3	20.5
Chuck	11.7	14.6	12.9
Porterhouse	3.5	3.0	3.3
Rib	3.0	1.5	2.3
Wing	2.0	3.0	2.5
Minute	1.0	3.0	2.0
Other	2.0	2.5	2.2
No preferences, all types	5.1	5.1	5.1
Total percent	100	100	100
Total number of consumer responses	198	198	396

^a This refers to the types of steak bought both most often and second most often. Thus the total number of consumer responses included is $2 \times 198 = 396$.

Table 44

Preparation Methods Used for the Types of Steak Bought Most Frequently^a

Method of Preparation	Type of Steak	Sirloin (%)	Round (%)	T-bone (%)	Chuck (%)	Porter-house (%)	Rib (%)	Wing (%)	No preference (%)	Minute steak (%)	Other (%)	Total ^a (%)
Broil or barbecue		75.5	29.0	70.4	72.5	76.9	66.7	90.0	65.0	50.0	77.8	62.4
Pan-fry		19.6	19.4	24.7	7.8	7.7	22.2	10.0	20.0	37.5	11.1	18.9
Braise		1.0	40.8	-	17.7	7.7	11.1	-	15.0	-	-	13.1
Pan-broil		-	-	1.2	-	7.7	-	-	-	-	-	0.5
Roast		1.0	3.2	2.5	2.0	-	-	-	-	12.5	-	2.0
Stew		1.0	5.4	1.2	-	-	-	-	-	-	11.1	2.0
Oil fondue		1.9	1.1	-	-	-	-	-	-	-	-	0.8
Other		-	1.1	-	-	-	-	-	-	-	-	0.3
Total percent		100	100	100	100	100	100	100	100	100	100	100
Total number of consumer responses		102	93	81	51	13	9	10	20	8	9	396

^a This refers to the types of steak bought both most often and second most often. Thus the total number of consumer responses is $2 \times 198 = 396$.

Consumer satisfaction with beef steak purchases. The majority of consumers interviewed were, for the most part, satisfied with their steak purchases. As illustrated by Table 45, the majority of consumers, 62 percent (123), were disappointed in the quality of the steak they purchased only 5 percent or less of the time. Of the 38 percent (61) whose expectations were unfulfilled more often than this, the largest proportion felt that this occurred between 6 and 30 percent of the time. Only 6 percent (12) of the respondents were dissatisfied more often than 30 percent of the time. The most frequent complaint voiced about the quality of the beef, as illustrated in Table 46, was that it was tougher than expected. This was logical, since tenderness was the most important criteria used by consumers to judge quality of a cooked steak. In addition, the tendency on the part of consumers to avoid marbling, would increase the probability of their purchasing less tender steaks. Some respondents were more specific as to the nature of their complaints and added that the meat was tough, stringy and chewy. There were relatively few complaints about poor flavour, dryness or excessive fat.

Those consumers who usually bought sirloin steak were dissatisfied with their beef purchases the least often, while those who usually bought porterhouse steak judged the meat most often to be of poorer quality than expected (Table 47). This may or may not be related to the price of porterhouse steaks, in that those consumers paying the highest prices would be expected to have the highest expectations with regard to quality. Round steak also incurred a large number of dissatisfied customers. The remaining types, even chuck steak showed a better record than round steak but poorer than sirloin. However, statistical testing showed no significant

differences in the degree of dissatisfaction among the four types of steak bought most frequently (Table 48).

Table 45

Estimated Frequency of Disappointment
with Beef Steak Quality

Estimated frequency	Percentage of respondents
never	22.7
$\leq 5\%$	39.4
6 - 10%	15.2
11 - 20%	7.6
21 - 30%	8.1
31 - 40%	1.5
41 - 50%	2.0
$> 50\%$	2.5
Unable to estimate %	1.0
Total percent	100
Total number of consumer responses	198

Table 46

Primary Complaints Voiced by Consumers
Concerning Beef Quality

Primary Complaint	Percentage of respondents
Tough	51.5
Tough, stringy, chewy	10.1
Dry	1.5
Poor flavour	3.5
Tough, poor flavour	6.6
Excessive fat	1.5
Visible area lean, underneath fat	0.5
Coarse texture	1.0
Other	1.0
No complaints voiced	22.8
Total percent	100
Total number of consumer responses	198

Table 47

The Relationship Between the Frequency of Disappointment with Beef Steak Quality and the Types of Steak Bought Most Frequently^a

Type of Steak Frequency	Sirloin (%)	Round (%)	T-bone (%)	Chuck (%)	Porter- house (%)	Rib (%)	Wing (%)	No preference (%)	Minute steak (%)	Other (%)
Never	22.4	22.6	22.2	21.6	15.3	33.3	20.0	45.0	12.5	11.1
≤5%	43.9	31.2	43.2	43.1	23.1	33.3	50.0	45.0	37.5	44.4
6 - 10%	10.2	20.4	11.1	19.6	38.5	11.1	10.0	10.0	12.5	22.2
11 - 20%	6.1	11.8	9.9	3.9	7.7	-	10.0	-	12.5	-
21 - 30%	9.2	7.5	11.1	7.8	7.7	11.1	-	-	-	11.1
31 - 40%	4.2	1.1	-	-	-	11.1	-	-	-	-
41 - 50%	2.0	1.1	-	2.0	7.7	-	-	-	25.0	11.1
> 50%	2.0	4.3	2.5	2.0	-	-	10.0	-	-	-
Total percent	100	100	100	100	100	100	100	100	100	100
Total number of consumer responses ^a	98	93	81	51	13	9	10	20	8	9

^a This refers to the types of steak bought both most often and second most often. Thus the total number of consumer responses, excluding those respondents who were unable to estimate a frequency, is equal to 2 x 196 = 392.

Table 48

Chi-Square Distribution^a of the Frequency of Disappointment
with Beef Steak Quality Among the Four Types
of Steak Bought Most Frequently

Frequency \ Type of Steak	Round	Sirloin	Chuck	T-bone	Total
≤ 5%	50	65	33	53	201
> 5%	43	33	18	28	122
Total	93	98	51	81	323

^a Actual $\chi^2 = 4.02$, $P > 0.05$ with 3 df. (Theoretical $\chi^2 = 7.81$).

In the case of the normally less tender types of steak, round and chuck steak in particular, it appeared that those who used the generally recommended moist heat methods of cooking reported a higher frequency of satisfaction than those who incorrectly used dry heat methods (Table 49). In the case of round steak, 50 percent (23) of those who broiled or pan-fried reported that they had poor quality steak more often than this. However 64 percent (30) of those who used moist heat methods reported poor quality steak only 5 percent of the time, and only 37 percent (17) reported it more often than this. The same was true in the case of chuck steaks, where 63 percent (26) of those who used dry heat methods reported poor quality steak less than or equal to 5 percent of the time, as compared to 90 percent (9) of those who used moist heat methods who reported the same low degree of dissatisfaction. However,

the differences in degree of dissatisfaction between moist and dry heat were not statistically significant. This suggests that the general cooking method recommendations may not be appropriate for each and every consumer. For example, 9 percent (18) of the consumers in this study considered flavour of a cooked steak to be more important than tenderness, whereas the general recommendations are designed to assure maximum tenderness.

Table 49

The Relationship^a Between the Frequency of Disappointment
with Beef Steak Quality and the Cooking Methods
Used for Less Tender Cuts

Frequency	DRY HEAT			MOIST HEAT		
	Round steak	Chuck steak	Total	Round steak	Chuck steak	Total
Never	(No.) 9	11	20	13	4	17
	(%) 19.6	26.8	23.0	27.7	40.0	29.8
≤5%	(No.) 14	15	29	17	5	22
	(%) 30.4	36.6	33.3	36.2	50.0	38.6
6 - 10%	(No.) 11	8	19	6	-	6
	(%) 23.9	19.5	21.8	12.8	-	10.5
11 - 20%	(No.) 7	3	10	4	-	4
	(%) 15.2	7.3	11.5	8.5	-	7.0
>20%	(No.) 5	4	9	7	1	8
	(%) 11.0	9.8	10.4	14.8	10.0	14.1
Total number of consumer responses ^b	46	41	87	47	10	57
Total percent	100	100	100	100	100	100

^a Actual $\chi^2 = 4.54$ for dry vs. moist heat, $P > 0.05$ with 4 df. (Theoretical $\chi^2 = 9.49$).

^b Total number of consumer responses included = 144.

The frequency of dissatisfaction with beef purchases did not appear to be related to either the characteristics used by consumers to choose between steaks of the same type and price, or the characteristics used to judge quality in a cooked steak (Table 50 and Table 51). However, those who considered the dimensional characteristics of a steak, such as size or the number of servings provided, showed a tendency to be satisfied with their steak purchases more often than those who used other criteria. These consumers may have been less discriminating when judging quality of a cooked steak. This seems logical, since the appearance or characteristics of the meat itself were secondary to them. There was also a tendency for those consumers who judged the quality of a cooked steak primarily by the characteristics of juiciness or lack of greasiness, to be dissatisfied less often with their steak purchases, than those who used the criteria of tenderness, flavour or texture. Few people, however, considered juiciness or greasiness characteristics to be of prime importance (Table 17).

Those consumers who chose the better quality Grade A steaks as being the most desirable among the set of four sample steaks, were no more satisfied with their steak purchases on the whole than were those who chose the Grade B steaks (Table 52). There was no indication then, that the Grade A steak choosers were generally more adept at visually judging beef quality. However, in general, those people who chose steaks of the higher marbling levels 3 and 4, tended to be disappointed in their steak purchases somewhat less often than those choosing the lower marbling levels. Of those consumers choosing marbling levels 1 and 2, only 54 percent (54) reported being disappointed in the quality of their steak purchases as seldom as 5 percent of the time. In contrast, 70 percent (49)

of those consumers choosing marbling levels 3 and 4 reported such a low frequency of degree of disappointment. It appears that consumers who exhibit a preference for more highly marbled beef tend to have better luck with their beef purchases.

Table 50

The Relationship^a Between the Frequency of Disappointment with Beef Steak Quality and the Most Important Characteristic Used to Choose Between Steaks of the Same Type and Price

Characteristics Frequency		Colour of lean	Amount of fat	Amount of marbling	Amount of bone	Dimensional Characteristics ^b
Never	(No.)	10	20	3	3	7
	(%)	22.2	22.2	18.8	17.6	38.9
≤5%	(No.)	18	35	6	8	6
	(%)	40.0	38.9	37.4	47.2	33.3
6 - 10%	(No.)	8	16	2	3	-
	(%)	17.8	17.8	12.5	17.6	-
11 - 20%	(No.)	5	8	2	-	-
	(%)	11.1	8.9	12.5	-	-
>20%	(No.)	4	11	3	3	5
	(%)	8.9	12.2	18.8	17.6	27.8
Total number of consumer responses ^c		45	90	16	17	18
Total percent		100	100	100	100	100

^a Actual $\chi^2 = 13.86$, $P > 0.05$ with 16 df. (Theoretical $\chi^2 = 26.30$).

^b Includes characteristics such as size of steak, thickness, etc.

^c Total number of responses included = 186.

Table 51

The Relationship^a Between the Frequency of Disappointment with
Beef Steak Quality and the Most Important Characteristics
Used to Judge Quality of Cooked Steaks

Characteristics		Frequency				
		Tenderness	Flavour or taste	Juiciness	Texture	Freedom from greasiness
Never	(No.)	36	4	1	1	3
	(%)	22.6	22.2	10.0	16.7	100.0
≤5%	(No.)	62	7	7	2	-
	(%)	39.0	38.9	70.0	33.3	-
6 - 10%	(No.)	27	2	-	1	-
	(%)	17.0	11.1	-	16.7	-
11 - 20%	(No.)	11	1	2	1	-
	(%)	6.9	5.6	20.0	16.7	-
>20%	(No.)	23	4	-	1	-
	(%)	14.5	22.2	-	16.7	-
Total number of consumer responses ^b		159	18	10	6	3
Total percent		100	100	100	100	100

^a Actual $\chi^2 = 13.36$, $P > 0.05$ with 16 df. (Theoretical $\chi^2 = 26.30$).

^b Total number of responses included = 196.

Table 52

The Relationship^a Between the Frequency of Disappointment with
Beef Steak Quality and Marbling Level of the
Most Preferred Sample Steak

Marbling Level		1	2	3	4
Frequency		(Grade B)	(Grade A)	(Grade A)	(Grade A)
Never	(No.)	14	3	10	11
	(%)	19.4	11.1	27.0	33.3
≤5%	(No.)	26	11	17	11
	(%)	36.1	40.7	45.9	33.3
6 - 10%	(No.)	12	6	5	6
	(%)	16.7	22.1	13.5	18.2
11 - 20%	(No.)	9	2	2	2
	(%)	12.5	7.5	5.4	6.1
>20%	(No.)	11	5	3	3
	(%)	15.3	18.5	8.2	9.1
Total number of consumer responses ^b		72	27	37	33
Total percent		100	100	100	100

^a Actual $\chi^2 = 9.45$, $P > 0.05$ with 12 df. (Theoretical $\chi^2 = 21.03$).

^b Total number of responses included = 169.

Neither the type of store where the respondents did most of their meat shopping, nor the method used to select meat, showed statistically significant relationships to the frequency of disappointment in steak quality (Table 53 and Table 54). However, some tendencies were apparent. Only 21 percent (27) of those consumers who did most of their meat shopping at a large supermarket reported a perfect record of receiving good quality beef, while 27 percent (15) of those who shopped at a butcher shop reported the same degree of success. In addition, 90 percent (9) of those who used their own judgement to choose unwrapped meat from behind a butcher counter considered themselves to be unsuccessful only 5 percent or less of the time, whereas only 54 percent (42) of those who bought prepackaged meat were dissatisfied as seldom. Sixty-five percent (42) of those who always used butcher service were unsuccessful 5 percent or less of the time, while 70 percent (3) of those who used a combination of butcher service and prepackaged beef had the same low frequency of dissatisfaction.

Consumers who used beef in more than 90 percent of their meals involving some form of meat reported disappointment in steak quality significantly less often ($X^2 = 5.75$, $P < 0.05$ with 1 df.) than those who used beef in only 49 percent or less of their meals. Seventy-eight percent (29) of the former group reported disappointment in steak quality only 5 percent or less of the time, as compared to 48 percent (10) of the latter group (Table 55). A similar situation exists when comparing high and low frequency steak users. Those consumers who used steak two or more times per week were dissatisfied with the quality significantly less often ($X^2 = 4.27$, $P < 0.05$ with 1 df.) than those who used it only once per month. Seventy-three percent (3) of the more frequent users

Table 53

The Relationship^a Between the Frequency of Disappointment with
Beef Steak Quality and the Type of Store Where
Most of the Meat Shopping is Performed

Type of Store		Super-	Butcher		Frozen	
Frequency		market	Shop	Farmer	food store	Bulk supplier
Never	(No.)	27	15	1	-	2
	(%)	20.6	27.3	25.0	-	100.0
≤5%	(No.)	55	18	2	3	-
	(%)	42.0	32.8	50.0	75.0	-
6 - 10%	(No.)	21	8	1	-	-
	(%)	16.0	14.5	25.0	-	-
11 - 20%	(No.)	9	6	-	-	-
	(%)	6.9	10.9	-	-	-
> 20%	(No.)	19	8	-	1	-
	(%)	14.5	14.5	-	25.0	-
Total number of consumer responses ^b		131	55	4	4	2
Total percent		100	100	100	100	100

^a Actual $\chi^2 = 13.90$, $P > 0.05$ with 16 df. (Theoretical $\chi^2 = 26.30$).

^b Total number of responses included = 196.

Table 54

The Relationship^a Between the Frequency of Disappointment with Beef Steak Quality and the Methods Used to Shop for Beef

Frequency \ Method	Butcher's advice always	Pre-packaged always	Both butcher & pre-packaged	Own judgement - chose from counter
Never	(No.) 14	16	10	5
	(%) 21.5	20.5	23.3	50.0
≤ 5%	(No.) 28	26	20	4
	(%) 43.1	33.3	46.5	40.0
6 - 10%	(No.) 11	15	4	-
	(%) 16.9	19.2	9.3	-
11 - 20%	(No.) 4	7	3	1
	(%) 6.2	9.0	7.0	10.0
> 20%	(No.) 8	14	6	-
	(%) 12.3	17.9	13.9	-
Total number of consumer responses	65	78	43	10
Total percent	100	100	100	100

^a Actual $\chi^2 = 11.18$, $P > 0.05$ with 12 df. (Theoretical $\chi^2 = 21.03$).

^b Total number of responses included = 196.

Table 55

The Relationship Between the Frequency of Disappointment with
Beef Steak Quality and the Percentage
of Meals Involving Beef

Frequency \ % of meals							
		≤49%	50-59%	60-69%	70-79%	80-89%	≥90%
Never	(No.)	6	6	5	14	4	10
	(%)	28.6	17.1	25.0	23.3	17.4	27.0
≤5%	(No.)	4	14	6	26	9	19
	(%)	19.0	40.0	30.0	43.3	39.1	51.4
6 - 10%	(No.)	6	5	2	6	6	5
	(%)	28.6	14.3	10.0	10.0	26.1	13.5
11 - 20%	(No.)	-	3	2	7	2	1
	(%)	-	8.6	10.0	11.7	8.7	2.7
>20%	(No.)	5	7	5	7	2	2
	(%)	23.8	20.0	25.0	11.7	8.7	5.4
Total number of consumer responses ^a		21	35	20	60	23	37
Total percent		100	100	100	100	100	100

^a Total number of responses included = 196.

reported disappointment in steak quality only 5 percent or less of the time, as compared to only 50 percent (17) of the less frequent users (Table 56). It appears then that high frequency beef and steak users are either more successful visual judges of beef quality, or less demanding judges of cooked quality. However, there is no evidence to suggest that they are more successful visual judges of beef quality, in that in this study they were no more inclined than the low frequency users to prefer Grade A to Grade B steaks when choosing among the four sample steaks.

Those consumers who used beef grades as a buying guide apparently had better success with their steak purchases than those who did not. The grade "users" reported disappointment significantly less often ($\chi^2 = 4.99$, $P < 0.05$ with 1 df.) than the "non-users". Seventy-two percent (57) of the users received poor quality steak only 5 percent or less of the time, whereas only 56 percent (66) of the non-users received poor quality steak as seldom (Table 57). However, no such trend was evident when the consumers buying "Red brand" beef were compared to those buying other grades of beef ($\chi^2 = 0.64$, $P > 0.05$ with 1 df.) (Table 58). This makes it difficult to draw any definite conclusions about the effect of the use of grades as a buying guide, on the satisfaction with steak purchases.

While 39 percent (78) of the consumers saw no need for more information on labels of prepackaged meats, 61 percent (120) felt that the information presently available, such as price per pound and name of the cut, is inadequate (Table 59). The most popular suggestion was to have the recommended cooking methods for the various cuts printed right on the package -- especially for the smaller convenience cuts. While this information is generally readily available in cookbooks, some consumers found

Table 56

The Relationship Between the Frequency of Disappointment with
Beef Steak Quality and the Frequency
with Which Steak is Served

Frequency of Frequency serving		2 or more x per week	one x per week	2 or 3 x per month	At least 1 x per month
Never	(No.)	8	21	7	9
	(%)	19.5	28.4	14.9	26.5
≤ 5%	(No.)	22	23	25	8
	(%)	53.7	31.1	53.2	23.5
6 - 10%	(No.)	6	12	6	6
	(%)	14.6	16.2	12.8	17.6
11 - 20%	(No.)	3	5	4	3
	(%)	7.4	6.8	8.5	8.9
> 20%	(No.)	2	13	5	8
	(%)	4.8	17.5	10.6	23.5
Total number of consumer responses ^a		41	74	47	34
Total percent		100	100	100	100

^a Total number of responses included = 196.

Table 57

The Relationship^a Between the Frequency of Disappointment with
Beef Steak Quality and the Use Made of the Grading System

Frequency		Grade users	Grade non-users
Never	(No.)	19	26
	(%)	24.1	22.2
≤5%	(No.)	38	40
	(%)	48.1	34.3
6 - 10%	(No.)	11	19
	(%)	13.9	16.2
11 - 20%	(No.)	2	13
	(%)	2.5	11.1
>20%	(No.)	9	19
	(%)	11.4	16.2
Total number of consumer responses ^b		79	117
Total percent		100	100

^a $\chi^2 = 4.99$, $P < 0.05$ with 1 df. (Theoretical $\chi^2 = 3.84$).

^b Total number of responses included = 196.

Table 58

The Relationship Between the Frequency of Disappointment
with Beef Steak Quality and the Grade^a
of Beef Usually Purchased

Grade								
Frequency		Red Brand	Blue Brand	Red or Blue	Top Grade	Grade A	Grade B	Cheapest
Never	(No.)	11	4	2	-	-	1	1
	(%)	31.4	30.8	11.9	-	-	100.0	100.0
≤5%	(No.)	12	6	9	5	6	-	-
	(%)	34.3	46.2	52.9	62.5	100.0	-	-
6 - 10%	(No.)	4	3	3	2	-	-	-
	(%)	11.4	23.1	17.6	25.0	-	-	-
11 - 20%	(No.)	2	-	-	-	-	-	-
	(%)	5.7	-	-	-	-	-	-
>20%	(No.)	6	-	3	1	-	-	-
	(%)	17.2	-	17.6	12.5	-	-	-
Total number of consumer responses ^b		35	13	17	8	6	1	1
Total percent		100	100	100	100	100	100	100

^a Refers to grading system used prior to September 5th, 1972.

^b Total number of responses included = 81. Table does not include those consumers who do not buy by grade.

Table 59

Additional Information Desirable on Labels
of Prepackaged Meats

Desirable information	First suggestion (%)	Second suggestion (%)	Total (%)
None	39.4	39.4	39.4
Suggested cooking methods, recipes, etc.	22.7	8.1	15.4
Number of servings/pound	1.5	3.5	2.5
Length of aging time	2.0	1.0	1.5
Grade, quality	19.2	3.5	11.4
Code dating	8.1	5.1	6.6
Inspection information	2.0	2.0	2.0
State if previously frozen	1.0	1.0	1.0
Additives present, if any	1.0	2.0	1.5
Other	3.0	-	1.5
No further suggestions	-	34.3	17.2
Total percent	100	100	100
Total number of consumer responses	198	198	396

that they were unable to utilize it adequately, due to the confusion in the naming of the cuts. For example, cookbooks do not usually refer to beef cuts such as "Cowboy steaks" and "Spencer steaks". The grade or quality of the cut was also of interest to a considerable proportion of respondents. This information could become increasingly important in view of the fact that when the exterior fat cover on a carcass of beef is trimmed to a suitable retail thickness, the grade stamp is often removed. Some consumers also suggested code dating of fresh meat, to indicate either the length of time the meat was aged, or the date of packaging. Various other suggestions raised included the number of servings that could be expected per pound, inspection information, whether or not the meat had been frozen at some time, and what additives, if any, were present. However, while many consumers were in favour of additional information on labels, many cautioned that they would rather do without, if it involved an increase in the price of beef.

SUMMARY AND CONCLUSIONS

Beef purchases constitute a substantial and growing proportion of the food budget for many Canadians. Almost 90 percent of the 198 respondents surveyed in the study use beef in 50 percent or more of their meals in which some form of meat is served. With an increasing number of people buying prepackaged meat, it is important that consumers use reliable indicators of eating quality, in order to obtain maximum satisfaction. The results of this study indicated a strong relationship between visual attributes and eating quality. The fact that the new grading system is based on factors affecting both visual and eating preferences, implies that consumers could use it as a reliable indicator of beef quality.

Differences were found in eating quality of the longissimus dorsi muscles between steaks of Canada A and Canada B grade beef. Results of objective and sensory tests on cooked steaks indicated that generally Grade A steaks were less firm or tough, more juicy and less chewy than Grade B steaks. These differences in eating quality were due to differences in the amount of marbling in the steaks, since other grade differentiating factors were held constant. Some marbling appeared to be essential for beef to have a high potential for eating satisfaction. While differences in eating quality were evident between steaks "practically devoid" of marbling and steaks with a higher degree of marbling, no differences were evident among steaks with "slight", "small" and "modest" amounts of marbling. Under the new grading schedule, one of the distinguishing characteristics between Grade A and Grade B is that for a carcass to be classified Grade A, it must have at least a slight

amount of marbling, while there is no minimum for Grade B carcasses.

Consumers generally preferred the visual characteristics of Grade B steaks to Grade A steaks. The most important characteristic influencing the choice of most consumers was the amount of marbling. The respondents were well able to recognize the characteristic of marbling and to distinguish among the different levels. While they had definite ideas about what marbling meant to them, it meant different things to different people. Some, feeling that it enhanced the eating quality of the beef, chose steaks of higher marbling levels. However many, feeling that marbling fat was waste, or comparable to sinew and gristle, preferred steaks of the lower marbling levels. This explains the overall preference for B grade steaks which were "practically devoid" of marbling. Laboratory tests showed that Grade B steaks were less tender and less juicy than steaks with more marbling. Accordingly consumers who deliberately avoided any marbling incorrectly interpreted the significance of marbling to eating quality.

Of the general criteria used by consumers to choose between steaks of the same type and price, the amount of external fat was reported most frequently to be the most important. The respondents associated external fat with waste, and as such thought it to be undesirable. They did not, as a general rule, associate it with the eating characteristics of the cooked product.

The colour of lean was also reported to be an important determinant of consumer choice among steaks of the same type and price, being second only to the amount of fat. However, while external fat was considered to be simply a problem of waste, the colour of lean was used as an indicator of the eating quality potential of the cooked product.

Consumers preferred "red" or "bright red" lean, and associated it with freshness of the raw product and subsequent satisfaction with the cooked product. On the other hand any discoloured or dark lean indicated that the product was stale.

Consumers in this study were generally not concerned with the firmness-to-touch or with the texture of raw lean meat. Very few respondents associated either of these characteristics with the quality of the meat, and thus the majority paid little or no attention to these traits. In addition the respondents reported that the amount of bone was an important determinant of choice between steaks of the same type and price. However, very few were concerned about the visual characteristics of the bone itself, other than its size.

There were no statistically significant differences among the reasons given for sample steak choices, between the consumers choosing Grade A and Grade B beef. It would appear then, that while consumers had definite preferences, their reasons for having the same preferences varied considerably. That is, different characteristics of the steaks were important to different people, for different reasons.

Consumers in this survey made little use of the beef grading system used prior to September 5th, 1972. Only 18 percent of those surveyed specifically purchased Choice grade cuts, and they reported satisfaction with eating quality no more often than those who did not. Many respondents confused inspection with grading and were unable to distinguish between the inspection and grading stamps. Many were not even aware that grading was performed to establish quality designations for beef.

Few relationships were evident between consumer shopping and

serving practises and their satisfaction with steak purchases. In addition, in this study, there was no evidence to suggest that Grade A steak choosers were generally more satisfied with their steak purchases than were Grade B steak choosers, and thus that they were more adept at visually judging beef quality. These results make it difficult to distinguish clearly between a group of successful shoppers and a group of unsuccessful shoppers. Consumers were generally satisfied with their steak purchases, with 62 percent reporting disappointment with the eating quality only 5 percent or less of the time. Sirloin steak appeared to be the most satisfactorily purchased cut. The method of cooking also tended to influence the satisfaction with steak purchases, since those consumers who used moist heat methods for the less tender cuts, such as chuck and round steak, tended to report satisfaction with their steak more often than those who used dry heat methods. There were no strong relationships between the characteristics used by consumers to choose steaks, or to judge quality in cooked steak, and the frequency of dissatisfaction with steak purchases. However, consumers who used large quantities of beef or steak in their menus, were more satisfied with their steak purchases than were those who used minimal amounts. It seems that high frequency beef users are either more successful visual judges of beef quality, or less demanding judges of cooked quality.

It would appear then that Canada's new beef grading system, as well as classifying beef into groups which are more homogeneous in certain characteristics than the entire set, is in fact a reliable indicator of beef quality. By taking into consideration those factors which have been found to affect both visual and eating preferences, the system ensures that Canada A grade beef will have the highest probability of

satisfying the demands of the majority of consumers. The same could not be said of the previous grading system. As such, the new schedule can assist consumers to select beef with desirable eating and visual characteristics. While research has shown that the colour of lean is not a reliable indicator of eating quality, in view of its importance to consumer visual preferences as confirmed in this study, the grading system assures that Grade A beef is bright red, while Grade B beef may range in colour from bright red to medium dark. While external finish is important to consumer preferences, since many consumers view it as waste, it has not been found to affect the eating quality of beef. This fact is appropriately recognized by the new grading schedule which places little emphasis on fat cover as a determinant of eating quality. On the other hand, the firmness and texture of raw lean have both been found to affect eating quality. While consumers in this study were not concerned about these characteristics, the grading system does recognize their importance to eating quality, and discriminates against beef which is soft or coarse grained. All Canada A grade beef must be firm and fine grained, while Canada B beef may be only moderately firm, and somewhat coarse in texture.

The results of this study suggest that Canada's new beef grading system has the potential to be a useful guide to consumers in selecting beef with desirable eating characteristics. For this potential to be realized it will be necessary to inform consumers clearly about the structure and functions of this system of grading. The previous grading system was not meaningful to many consumers and was not consistently used by them. Consumers do have definite visual criteria for choosing beef but this study showed that many did not use the criteria found to be most appropriate for judging eating quality. Furthermore, those that

did use appropriate criteria often misjudged their significance to eating quality. For example, when choosing among the sample steaks, the majority of consumers used marbling as the main selection criteria, but many of these incorrectly assumed marbling to be disadvantageous. It seems likely that the apparent need of consumers for direction in beef selection may be satisfied by precise explanation of the basis for the new grading system and its significance to eating quality.

RECOMMENDATIONS

Considerable consumer education will be necessary if consumers are to profit from the beef grading system. It is essential that consumers be made more aware of (a) the distinction between significant and insignificant determinants of eating quality, and (b) how these characteristics affect eating quality. The results of this study suggest that the presence of some marbling is particularly relevant to tender, juicy beef. The obvious misunderstanding on the part of many consumers with regard to the significance of this characteristic must be corrected. In addition, the design of the new grading system must clearly be explained to consumers, if grades are to be more meaningful than they have been in the past. The grade names themselves, A, B, etc., suggest a quality designation that, from the results of this study, appear to be justified in terms of tenderness and juiciness characteristics of the cooked beef. However, it must be made clear to consumers that the fat classification numbers such as A1, A2, A3, etc., are indicative of the amount of external fat only, and as such are not related to the potential eating qualities of cooked beef. In view of consumers' past problems with understanding the grading system, it seems that the fat level designations could be a logical source of confusion.

From the results of this study, it appears that consumers would be very receptive to promotional information designed to educate, rather than simply to advertise. Sixty percent of the respondents were in favour of more information on labels of prepackaged meats than is currently available. Such point-of-purchase information, including stamping the grade directly on the package, would be an inexpensive and

feasible means of increasing consumer awareness of the beef grading system. The point-of-purchase would likely be the most logical place to inform consumers regarding beef selection to maximize the eating qualities which are of particular importance to them. For example, posters illustrating a desirable marbling level and its significance to eating quality, may help to reduce consumer confusion with regard to this characteristic. Suggested cooking methods on the labels of prepackaged meats may also help increase consumer satisfaction with beef purchases. Other media, such as educational television and radio, school programming and newspaper and magazine articles could also be used to teach consumers how to successfully shop for beef.

The grading system was intended to benefit all aspects of the beef industry, including consumers. Hopefully, improved consumer understanding of beef grades and of beef quality, will enable feedback of consumer wants through the marketing system to producers. Only in this way will the improvements in the system benefit all concerned.

AREAS FOR FURTHER STUDY

The sensory data from this study were obtained using a trained laboratory panel, and as such do not necessarily represent the opinions of the average consumer. Further research involving consumer hedonic scores for the textural and flavour characteristics of cooked Grade A and Grade B beef would be a natural step in the process of evaluating the grading system. While initial research would involve obtaining consumer response to beef cooked and prepared under controlled conditions, subsequent studies may be warranted where the participants would be allowed to prepare and eat the beef in their own homes, according to their own preferred methods. Such research would contribute significantly to the ultimate evaluation of the new beef grades from the consumer standpoint.

In addition, further consumer and laboratory testing might make it possible to predict, through regression analyses, consumer acceptance of cooked beef from the characteristics of the raw meat. Among other things, this would involve investigating the firmness-to-touch and the fineness of grain characteristics of raw beef, and their effect on the sensory attributes of the cooked product. These characteristics would be of particular interest first because the grading system takes them into account, and secondly because they could readily be perceived by consumers. Hopefully, such research would result in consumers being provided with more precise information regarding how to choose raw beef to maximize satisfaction with the cooked product.

Existing evidence suggests that consumers need direction to

choose beef with a high potential for maximum eating quality. However, before any consumer education program could be undertaken, it would be advisable to establish the most effective methods of influencing consumer purchasing habits. In effect, this would involve measuring the credibility gap which may exist between the consumer and the educational media.

Few studies are available in Canada regarding the usefulness of grades of agricultural products to consumers. While many areas are open to investigation, it would be a natural corollary to this research to study the effect of the fat index of hogs on consumer choice of pork at the meat counter, and on consumer satisfaction at the table. Such a study would attempt to establish relationships between grading standards, consumer choice criteria and laboratory measurements of pork products.

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APPENDICES

A. METHODS USED FOR PROXIMATE ANALYSIS

I. Modified Procedure for Moisture Determination of Tissue Samples, Vacuum Oven Method (A.O.A.C. 1965)

1. Weigh approximately 5 g of ground well mixed sample in previously tared aluminum weighing dish.
2. Dry for 24 hr at 80°C in partial vacuum (432 mm.).
3. Cool in dessicator and weigh.
4. Report moisture percentage as

$$\frac{\text{loss in weight}}{\text{weight of sample}} \times 100$$

II. Modified Procedure for Total Nitrogen Determination, Kjeldahl Method (A.O.A.C. 1965)

1. Weight approximately 2 g fresh sample, add 30 ml H_2SO_4 , sp. gr. 1.82, and kel-pak (Matheson No. 1).
2. Digest briskly until solution clears and then for an additional 30 minutes.
3. Cool, add 200 ml. water, zinc granules, and a layer NaOH-thiosulfate solution.
4. Immediately connect flask to distilling bulb on condenser and rotate flask.
5. Distill about 150 ml into a 2% boric acid solution containing a methyl-red, brom-cresol-green mixed indicator.
6. Titrate boric acid-indicator-distillate solution to end point with a dilute solution of hydrochloric acid to known normality.

7. Calculate percent nitrogen as
$$\frac{(S - B) \times N \times 1.4008}{\text{weight of sample}}$$

where S = ml of standard acid for sample
 B = ml of standard acid for blank
 N = normality of acid

8. Calculate percent protein as nitrogen x 6.25.

III. Procedure for Ether Extraction of Fresh Tissue,
Soxhlet Extraction Technique (A.O.A.C. 1965)

1. Weigh 1 - 2 grams well mixed sample. Wrap in filter paper (Whatman #2) and staple to form packet.
2. Dry sample in partial Vacuum (43 Cm Mercury) at 72°C for 24 hours.
3. Weigh sample. $\% H_2O = \frac{W_1 - W_2}{W_1} \times 100.$
4. Place samples in Soxhlet extraction flask and reflux with ethyl ether 24 hours.
5. Remove samples from ether and let stand in fume hood until ether dissapates (15 - 30 min.).
6. Dry samples in convection oven (60°C for 1 hour).
7. Cool in dessicator and weigh samples.
8. $\% E. E. = \frac{W_2 - W_3}{W_1} \times 100.$

B. CONSUMER QUESTIONNAIRE

Hello, I am _____, a graduate student at the University of Manitoba. For my Master's thesis, I am conducting a study about meat shopping habits. Your help would be most appreciated.

1. First of all, who in your household does most of the meat shopping?

(DO NOT READ LIST)

you alone ()
 spouse alone ()
 both ()
 other (specify) () _____

IF SPOUSE ALONE OR OTHER, END INTERVIEW.

Now I am looking for people with certain characteristics.

2. Are you married (INCLUDES WIDOWED OR DIVORCED) (), or single ().

(b) IF MARRIED: What is your (husband's) occupation? _____
 (wife's)

3. (a) Are you employed outside the home?
 Yes () No () Go to 4

(b) What is your occupation? _____

IF EITHER OF ABOVE IS IN THE MEAT INDUSTRY, OR IS A HOME ECONOMIST,
 END INTERVIEW.

4. Is anyone else in your household employed in the food industry or is a home economist?

Yes () Please specify _____

No () END INTERVIEW

5. In which age group do you fall? Just call off the number. (HAND

RESPONDENT CARD I) 1 2 3 4 5

CHECK WITH RANDOM SAMPLE DISTRIBUTION.

6. Now, I would like to get some idea about the BEEF served in your home?

As far as you can remember, how often are these meats served? (HAND

RESPONDENT CARD II). READ OFF MEATS TO RESPONDENT.

2 or more times/wk.	About once a week	2 or 3 times /month	About once a month	Less than once/mo.	Not at all in past 12 months
<u>STEAK (BEEF)</u>					
<u>POT ROAST</u>					
<u>OF BEEF</u>					
<u>OVEN ROAST</u>					
<u>OF BEEF</u>					
<u>STEW BEEF</u>					
<u>GROUND BEEF</u>					

IF STEAK NOT SERVED AT LEAST ONCE A MONTH, THANK, AND INDICATE COMPLETION OF INTERVIEW.

7. When you serve meat, approximately what percentage of the time would it involve beef? _____
8. Where do you usually buy your main supply of beef? (TYPE OF STORE & LOCATION IF POSSIBLE) _____
9. How many people do you usually shop for? _____
10. If you serve steaks in your home, who usually cooks them?

you alone	()
spouse alone	()
other (specify)	() _____
11. (a) What type of steak do you buy most often? _____
 (b) How is it usually prepared? _____
12. (a) What type of steak do you buy second most often? _____
 (b) How is it usually prepared? _____
13. What is the most important characteristic that you look for, when you select one steak over another of the same type and price? _____

IF RESPONDENT GIVES SEVERAL CHARACTERISTICS AT THIS TIME, CLARIFY WHICH HE CONSIDERS TO BE MOST IMPORTANT, AND FILL IN THE REST IN THE APPROPRIATE SPACES BELOW.

14. What is the second most important characteristic that you look for?

15. Are there any additional characteristics that you look for?

REPEAT, "Anything else" UNTIL THE ANSWER IS NO.

16. When you are eating a cooked steak, what is the most important characteristic that you look for when judging quality? _____

17. And what is the second most important characteristic? _____

18. Anything else? (REPEAT UNTIL ANSWER IS NO). _____

19. As far as you know, is the meat you buy INSPECTED, or isn't it?

Yes, it is	()	
No, it is not	()	IF <u>NO</u> OR <u>DON'T KNOW</u>
Don't know	()	SKIP TO QUESTION 20.

IF YES

(a) What does this inspection mean to you? _____

(b) How can you tell that meat has been inspected? _____

(c) Who do you think does this inspection of meat? _____

20. As far as you know, is the beef you buy GRADED, as distinguished from inspected or not?

Yes, it is	()	
No, it is not	()	IF <u>NO</u> , OR <u>DON'T KNOW</u>
Don't know	()	SKIP TO QUESTION 21

IF YES

(a) What does this grading indicate to you? _____

(b) How can you tell that beef has been graded? _____

(c) Who do you think does this grading of beef? _____

(d) Can you list any of the beef grades presently in use in Canada?

(e) Of the grades you mentioned, which is the top grade? _____

(f) Do you take the grade of the beef into consideration when doing
your meat shopping? No () Yes ()

IF YES, what grade do you usually buy? _____

SHOW STEAK TO RESPONDENTS

21. Now, I would like you to look closely at these four steaks. You may do anything that you would in a normal buying situation. If you were going to buy one of them, which one would you pick?

NOTE RESPONDENT'S ACTIONS - i.e. PICKING STEAKS UP, POKING, ETC.

22. Can you tell me why you selected that particular steak? What did you look for in picking it? _____

REPEAT "Anything else," until answer is NO. (IF ANSWER TO 22 is

"Thought it looked good", or SIMILAR STATEMENT, ASK "What about the piece made you think that?" BEFORE CONTINUING).

Your comments are very interesting. I would like to get a bit more detail about some of them.

IF ANSWER TO 22 INCLUDED SOME REFERENCE TO AMOUNT OR TYPE OF FAT, ASK:

23. (a) What type of fat did you mean? _____
- (b) What does the type of fat you are talking about indicate to you?

- (c) Is there anything else about the amount or type of fat that you would like to comment on. No ()
Yes () _____
- _____

IF ANSWER TO 22 INCLUDED SOME REFERENCE TO "COLOUR OF FAT" ASK

24. (a) What colour would you say the fat is on the steak you chose?

- (b) What does that indicate to you? _____
- (c) What colour of fat would you avoid? _____
- (d) What would that colour indicate to you? _____

IF ANSWER TO 21 INCLUDES "COLOUR OF LEAN" ASK

25. (a) What colour would you say the colour of the lean is on the steak you chose? _____
- (b) What does that colour indicate to you? _____
- (c) What colour of lean would you avoid? _____
- (d) What would that colour indicate to you? _____

IF ANSWER TO 22 REFERS TO "TEXTURE OR GRAIN", ASK

26. (a) How would you describe the texture of the steak you chose?

- (b) What does that texture indicate to you? _____
- (c) What texture would you try and avoid? _____

(d) What would that texture indicate to you? _____

IF ANSWER TO 22 INCLUDED REMARKS ABOUT THE "COLOUR OR CHARACTERISTICS OF THE BONE", ASK:

27. (a) How would you describe the bone on the steak you chose?

(b) What does that indicate to you? _____

(c) What type of bone would you try and avoid? _____

(d) What would that indicate to you? _____

IF ANSWER TO 22 INCLUDED ANY REFERENCE TO TENDERNESS, FRESHNESS, OR JUICINESS, ASK:

28. How do you judge _____ (FILL IN APPROPRIATE) from looking at the steak? _____

29. Now I would like you to rank the other four steaks in the display - i.e. which would be your second, third, and fourth choices?

2nd _____ 3rd _____ 4th _____

30. Would you be willing to pay more per pound for steak # _____, your first choice, than for steak # _____, your fourth choice?

Yes () No ()

IF ANSWER TO 30 IS YES, ASK:

31. How much more per pound would you be willing to pay? _____

IF ANSWER TO 30 IS NO, ASK:

32. Why would you not be willing to pay more for steak which has the characteristics you are looking for? _____

33. (a) Do you find when you serve steak that it is ever a different

quality than you thought it was when you bought it?

Yes () No ()

IF NO, GO TO 34

IF YES, ASK:

(b) What differences do you usually find? _____

(c) What percentage of the time would you estimate that this
occurs? _____

34. Do you depend on a butcher's advice for getting the right quality
of beef or do you buy prepackaged meat? _____

35. (a) Would you like to see more information on labels of prepackaged
meats, re suggested cooking methods, etc.

Yes () No ()

IF YES, ASK:

(b) What information in particular would you like to see, and why?

CARD I

1. 24 and under
2. 25 - 38
3. 35 - 44
4. 45 - 54
5. 55 and over

CARD II

2 or more times/week

About once a week

2 or 3 times/month

About once a month

Less than once/month

Not at all in past 12 months

Professional:

Architect	Lecturer
Artist	Librarian
Auditor	Musician
Barrister	Nurse
Chiropractor	Officer of ship
Chartered Accountant	Optometrist
Clergyman	Pharmacist (if owner, class 2)
Dentist	Photographer
Dietitian	Physician
Druggist	Radio Announcer - Commentator
Editor	Reporter
Engineer - chemical	School Inspector
mining	Social Service Worker
civil	Scientist
electrical	Surveyor
Journalist	Teacher
	Veterinarian

Business Executive: Owners - Managers

Broker	Manufacturer
Builder	Manufacturer's Agent
Contractor	Merchant
Dealer	Nurseryman
Exporter	Proprietor or Owner of any business
Efficiency Expert	Publisher
Hotel Keeper	President, Treasurer and Sec. Treas.
Jobber	of firm
Manager of any business, office	Superintendent (if in managing position)
or department	Undertaker
	Service station lessee

Salespeople:

Auctioneer	Elevator Agent (Grain)
Bond Salesman	Insurance Salesman
Bar Tender	Ice Salesman
Bread Salesman	Milk Salesman
Customers' Man (Stock Brokerage)	Soda Fountain
Commercial Traveller	Real Estate Agent
Clerk in store	

Clerical Workers:

Appraiser	Insurance Adjuster
Accountant	Office Worker
Bank Teller	Postman
Buyer - grain, etc.	Private Secretary
Bookkeeper	Purchasing Agent
Civil Service - Civil Servant	Stenographer
Customs Officer	Switchboard or Telephone Operator
Cashier	Stockkeeper
Credit Man	Station Agent
Investigator	Time Keeper
Insurance Inspector	

Skilled Labourer:

Automobile Body Builder	Candy Maker
Bus Driver	Carpenter
Baker	Cook
Barber	Crane Operator
Beauty Operator	Compositor (type setter)
Brush Maker	Dressmaker
Blacksmith	Dry Cleaner
Bricklayer	Draftsman
Baggage Master	Detective
Brakeman	Electrician
Butcher	

(cont'd...)

Skilled Labourer (continued)

Engineer - locomotive	Practical Nurse
stationary	Presser
marine	Printer
steam shovel	Prospector
radio transmitting eng.	Radio Serviceman
Fitter - general	Roofer
Fireman	Sawyer
Foreman	Sheet Metal Worker
Flying Instructor (civilian)	Sheriff
Gardener	Shipper
Garage Mechanic	Shoemaker
Gas Fitter	Signwriter
Hat Finisher	Steel Worker
Hand Tooler (furniture)	Stereotyper
Jeweller (if owner - Class 2)	Stonecutter or Stone Mason
Lineman	Street car conductor
Load Despatcher (railway)	Superintendent (apartment)
Logger	Fireman (train)
Lumber Grader	Tailor
Linotype Setter	Typewriter Mechanic
Mechanic	Tool Designer
Meter Man	Technician
Maintenance Man	Tool Setter
Machinist	Test Pilot
Motor Man	Trainman
Merchant Marine	Upholsterer
Millwright	Violin Maker
Moulder	Welder
Optician	Woodworker
Painter	War Worker
Plasterer	Tinsmith
Plumber	Embalmer
Policeman	

Unskilled Labourer:

Caretaker	Lumberman
Chauffeur	Millman
Drayman	Miner
Elevator Operator	Packer
Factory Worker	Restaurant Worker
Fisherman	Rooming-housekeeper
Gas Station Attendant	Stoker
Guard	Section Hand
Hospital Orderly	Taxi Driver
Incinerator Worker	Trackman
Janitor	Trapper
Labourer	Truck or Transport Driver
Laundress	Waiter or Waitress
Farm Hand	Watchman
Longshoreman	

Farmer (including tobacco growers (market gardeners) in rural - otherwise No. 5)

Widow and Spinster (living on income)

Pensioned and Retired

Unemployed

Armed Forces

Students

Rejects - Not Stated