

ACCEPTABILITY OF PORK DETERMINED BY CONSUMER  
IN-HOME TESTS AS RELATED TO INDICATORS  
OF FAT CONTENT

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Acceptability of Pork Determined by Consumer In-Home  
Tests as Related to Indicators of Fat Content.

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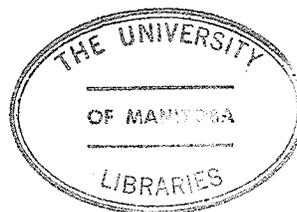
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Master of Science

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## ABSTRACT

The relationship between consumer acceptability and indicators of fat content in pork (index level, marbling, per cent fat) were examined using loin chops from sixty porcine carcasses selected and scored by a meat physiologist to fulfill four distinct index levels with fifteen carcasses in each index.

When judged by a six member trained sensory panel, there were no statistically significant differences found among index levels for the sensory dimensions of juiciness, tenderness and greasiness. However, a significant difference existed among index levels for the dimension of chew count. A quadratic relationship was found between index level and chew count, the two extreme index levels being most chewy.

Physical measurements on the cooked chops, consisting of Warner-Bratzler shear values, and General Foods texturometer juiciness measurements, showed no statistically significant differences among the four index levels studied. Percent lipid extraction was determined using the Soxhlet method of fat extraction which also showed no significant differences among the indices.

A total of 186 Winnipeg consumers of pork were interviewed to determine their pork shopping habits. It was found that consumers with a family size of 3 - 4 serve pork chops most frequently. In the age categories, younger consumers, less than 30 years of age, serve pork chops most frequently. Consumers over the age of 60 were the most infrequent servers of pork.

Of the 186 consumers interviewed, a total of 60 consumers were asked to participate in the take-home study to determine if there was a difference in consumer acceptability of the pork loin chops from the

four index groups. A Chi square relationship was calculated between index groups and the parameters in question. The amount of visible fat in the raw chops, amount of cooking loss, and three different sensory dimensions, tenderness, juiciness and greasiness of the cooked chops, were evaluated. Chi square analysis exhibited no statistically significant differences among index levels tested.

Neither the in-home tests by consumers nor the sensory and instrumental tests in the laboratory distinguished any differences in characteristics among loin chops from four index groups of hog carcasses.

The evidence from the present study indicates that the index system used in Canada is not related to the consumer complaint of pork being a fatty meat. A grading system based on carcass index would not be of benefit to consumers as it would not be a guide to the eating quality of pork. Pork from a wide range of carcass indices does not vary in its acceptability to the consumer.

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## INTRODUCTION

Recently there has been an upsurge in the consumption of pork and pork products in Canada. Despite this increase in consumption, pork receives the majority of consumer complaints in comparison to other meats on the market. The main concern about pork is its waste and "fatty" or greasy taste.

In December of 1968 the Canada Department of Agriculture implemented a new system of evaluating hog carcasses. The new system is an index system based on the concept of judging carcass merit as predicted by backfat and weight, giving a greater reward to the producer who markets hogs that yield a relatively high proportion of lean meat.

Producers, retailers and consumers of meat in general, are in agreement on the desirability of reducing fat content of hog carcasses to the minimum on the basis of economy, packing house operations and consumer preference for lean meat. Since the demand is for leaner meat or less fat, the question arises whether a change toward leaner carcasses results in meat of less desirable sensory quality.

The purpose of this study was to examine the acceptability of pork, determined by consumer in-home tests, as related to the indicators of fat content such as carcass index, marbling and lipid analysis. Laboratory, objective and sensory tests were performed in an attempt to explain differences in acceptability, if any, found by the consumers.

## REVIEW OF LITERATURE

Trends in Meat and Pork ConsumptionMeat Consumption in Canada

Statistics Canada (1975), reported that per capita total red meat consumption in Canada in 1974 was 75.6 kg. This is an increase of 2.2 kg per capita from 1973. Research by Faryna (1972) exhibits the frequency of serving different types of meat in the Winnipeg area. The order of frequency was found to be steak, chicken and then pork chops. These meats were consumed one time per week or more.

Meat and meat products continue to play an important role in the consumer expenditure of the food dollar. The Food Prices Review Board (1975) reported that for an average 4-person Canadian family in 1974, \$2,460 was spent on food. From Table 1, it can be seen that of this sum, \$935.00 was expenditure for meat and meat alternates and second on the list was fruit and vegetables which took \$440.00, a considerably smaller proportion of the total expenditure.

Table 1  
SUMMARY ANALYSIS OF FOOD SPENDING  
BY FOOD GROUP

FOOD GROUP	AVERAGE ANNUAL EXPENDITURE
Milk and Dairy Products	\$ 320
Fruit and Vegetables	440
Bread and Cereals	295
Meat and Alternates	935
Fats and Oils	125
Other	<u>345</u>
TOTAL Food Expenditure	\$2460

(Food Prices Review Board 1975)

### Pork Consumption in Canada

In August 1974, the Food Prices Review Board, as a response to consumer concern over rising food prices, issued a report on pork consumption. In 1973, per capita consumption of pork in Canada was 57.6 lb compared with 91.8 lb of beef and 46.9 lb of poultry meat. The consumption trend for pork has always varied from year to year, largely as a result of variability in pork prices. In recent years however, there appears to have been a steady upsurge in pork consumption (Table 2).

In the mid sixties, per capita consumption was about 50 lb per year. In the 1970's, consumption has averaged 61.5 lb reaching a peak of 65.9 lb in 1971 and declining to 57.6 lb in 1973, a year of large price increases. The evidence indicates that Canadian consumers have, in recent years, moved to a higher level of pork consumption. Perhaps the increase in the market for pork can be traced to the availability and prices of other competitive meats particularly beef and poultry. There appears to be a growth in the domestic market for pork that stems from a growing acceptability of pork by the Canadian consumer, although, there still do exist many consumer complaints about pork.

In April and May 1975 there was a sharp increase in hog prices in Canada. It is predicted by the Manitoba Hog Producers Marketing Board (1975) that supplies of hogs will continue to be tight for the rest of 1975. Since there will be a lower number of livestock available on the market the consumers will be affected by higher prices.

Table 2  
PORK CONSUMPTION IN CANADA  
1967 to 1974

YEAR	TOTAL 'm lbs.	PER CAPITA lbs.
1967	1,099	53.8
1968	1,114	53.6
1969	1,094	51.9
1970	1,184	55.3
1971	1,429	65.9
1972	1,334	61.1
1973	1,275	57.6
1974		59.9*

Statistics Canada (1973)

\* Statistics Canada Bulletin (1975)

## Consumer Studies

### Consumer Attitudes and Opinions Towards Meat

Meat is usually the focus of most meals in the Canadian culture and consequently this is the food product that is the focus of much consumer attention and complaint (Morris, et al., 1974).

In 1969, the U.S. Department of Agriculture undertook a nationwide study of homemakers opinions about selected meats (Weidenhamer et al., 1969). A total of 3,099 homemakers across the United States were interviewed. In the above study it was reported that when homemakers buy meat, their first consideration appears to be assurance of good quality.

Respondent "images" of the selected meats discussed in the report pointed out many interesting consumer impressions which the meat industry and meat researchers might find useful in further promotion of meat and meat products. It was not surprising to see that beef was found to be the meat most frequently consumed. Beef was described as tasty, easily digested, versatile, healthful, little or no waste and not being tiresome. Chicken, although not served as frequently as beef, was found to share favourable characteristics with beef. There did appear to be a concern with the consumers about the keeping qualities of chicken and the fact that it is a meat that one tires of quickly. Fresh pork products received the majority of the criticisms which will be discussed in a separate section.

In Canada, there have been no nationwide studies undertaken to evaluate consumer concerns about meat and meat products. A few studies have been done provincially and in some selected cities.

Stiles and McFadyen (1973a) and Faryna (1972) reported that many Canadian consumers have a lack of credibility in the food industry. It would appear that information on consumer concerns about meat, if obtained, could be used by the meat industry to improve its credibility with consumers. Stiles and McFadyen (1973a) undertook a study to evaluate consumer opinions of meat quality in Vancouver, Edmonton and Montreal. They found that over 90 per cent of the Canadian consumers interviewed considered the price of meat too high but over 50 per cent had not changed their meat purchasing patterns because of these increased prices in 1973. The most frequent change that had been made was to purchase cheaper cuts. Only 4 per cent indicated that they were purchasing less meat.

From a survey undertaken in Guelph, the respondents who did buy the less expensive cuts of meat mentioned the fact that the cheaper cuts were usually more fatty and therefore higher in calories. The Guelph consumers equated price with quality (Morris, et al., 1974).

The fat content of meats was the predominant consumer concern for all meat cuts. Skeletal cuts of beef and ground beef were characterized by an unexpected though apparently real consumer concern for added colouring. Fresh pork and, to a lesser extent, cured pork products were characterized by consumer concerns for "worms"(parasites). Extensively modified (pork sausage) and extensively processed meats (wieners) were characterized by poor quality ingredients and poor nutritive value. It was found that there were few concerns about lamb cuts or liver and other organ meats. This was attributed to a low consumption frequency.

The waste which occurs with meat products was also severely

criticized by the homemakers interviewed. The principal forms of waste were considered as fat and bone. For bone-in beef cuts, bone was cited as the main form of waste compared to fat which was cited as the main form of waste for equivalent pork cuts. Both Morris, et al., (1974) and Diamant et al., (1975) reported that almost all respondents wanted the minimum amount of fat possible on their meat cuts. The fattiness waste appeared to be an in-store judgement as opposed to an in-home judgement.

It is interesting to note the problems with meat that the Canadian consumer is unfamiliar with. Salmonella was the least known potential hazard in meats. In the Stiles and McFadyen (1973b) study, 51 per cent of all respondents were unfamiliar with this concern. This apparent lack of consumer information about salmonella would seriously limit the consumers ability to handle meat properly after purchasing.

A large proportion of respondents were unfamiliar with the food additives, nitrates and nitrites and the withdrawal of the hormone diethylstilbestrol (DES) from use in livestock. Respondents were even less familiar with intentional and incidental additives (mercury, pesticides, preservatives) and with saturated fats and cholesterol than with the mere general concerns such as parasites, poor nutritive value, poor quality ingredients, food poisoning and fat content. The unfamiliarity with these concerns is surprising in the light of the amount of attention that these concerns have received in the press (Hall, 1973). Hall claims that consumers do not have adequate information about potential hazards in foods. This places greater demand on the food industry and government organizations to provide credible information to the consumer. There exists a low level of consumer confidence in the food

industry because the consumer has not been informed about the safety and wholesomeness of meat and meat products as shown by the lack of awareness of meat inspection described by Stiles and McFadyen (1973a) and Forbes (1973).

#### Consumer Attitudes and Opinions Towards Pork

As mentioned previously, fresh pork and pork products received the majority of criticisms of all meats. A few studies have been undertaken to examine the attitudes of Canadian consumers towards pork and pork products.

Stiles et al., (1972) found that many criticisms and misconceptions exist about pork. The main criticisms were:

1. pork is difficult to digest
2. not always safe to eat
3. too much waste
4. not good to eat cold
5. does not keep well before cooking
6. not good for weight watching
7. tiresome
8. lack of versatility
9. very fatty meat
10. contains worms and parasites

The greatest concern was for waste in pork. There was a greater incidence of waste associated with fresh and cured pork cuts compared to beef cuts and whole chicken. This occurred despite claims that comparable cuts of pork frequently contain a lower fat percentage than beef (Stanley et al., 1973). These criticisms suggest that consumer prejudice or misconception exist about waste in pork. The concern for trichinella or "worms" would be attributed to a lack of education on the part of the

consumer and exposure to misinformation.

Diamant et al., (1975) examined consumer criteria for evaluation of cooked pork. In cooked chops tenderness was the most desirable characteristic. Flavour, then juiciness, leanness and lack of shrinkage on cooking were mentioned in that order of frequency. Expressions of dissatisfaction with quality of cooked pork focussed upon toughness or poor texture.

The many concerns which do exist about pork whether justifiable or not, may be corrected by information and educational programs, to change many of the opinions so that they are favourable to the acceptability of pork.

#### Characteristics of Pork Consumers

It was found by the ORC International Ltd. (1971) that of the factors influencing the attitudes towards pork and pork products, age of the respondents had a greater effect than either city or socioeconomic effects.

Weidenhamer (1969) in the U.S. nationwide survey found that as the age of the homemakers increased the frequency of serving pork decreased. This is in agreement with the findings of Stiles et al., (1972) and the O.R.C. International (1971). Older consumers had more definite unfavourable opinions about pork (Stiles et al., 1973) and were not prepared to buy pork products except ham. Younger consumers less than 25 years of age had less definite opinions about pork frequently expressing no opinion. However, these people did consider pork products except ham to be less tender than other meats.

Weidenhamer et al., (1969) also reported that smaller households were less likely to use fresh pork than medium or larger households. The use of bacon, luncheon meats and pork chops increased as the size of the family increased.

#### Consumer Studies Using Pork Samples

Before any concrete steps can be undertaken to improve the consumer image of pork, consumer preferences and criteria regarding pork must be determined. To date, in Canada there is no pork grading system at the retail level to guide consumers in its purchase as there is for beef. In the U.S. grades for pork have been established but are seldom used (Charley, 1970).

Trotter and Englemen (1959) undertook a study to see how consumers react to retail cuts of fresh pork derived from leaner and fatter carcasses. Pork chops and pork steaks were selected to be used in the study because pork chops were the most important retail cut and pork loins are the most handled wholesale cut. Table 3 shows the grades used with varying backfat thicknesses.

Table 3  
GRADES OF CARCASSES

<u>Grade</u>	<u>Backfat Thickness (inches)</u>
1	1.5 to 1.8
2	1.8 to 2.1
3	2.1 and over

The measurement of backfat thickness was taken over the last rib or first lumbar vertebra. The chops and steaks were displayed in retail stores with no marking of the grade but showing a price variation.

It was found that a portion of the consumers who were aware of alternative choices made their selection with an accurate knowledge of price differences, but little recognition of quality differences. These consumers selected Grades 2 and 3, the fatter and cheaper cuts. On the other hand, consumers who selected lean cuts, Grade 1, were accurate in identifying quality differences but were inaccurate in their observations of price differences. But, when the consumers were asked whether they thought they had chosen fat or lean pork, 75 per cent said that their selection was lean. Therefore, it would appear that consumers do take fat into account when selecting pork but the actual criteria for determining lean and fat is not known.

Gardner et al., (1960) also undertook a study of consumer preferences for pork. Photographs of lean, medium and fat chops were shown to the consumers; they were asked which one they preferred and why. Table 4 shows the number and percentage of respondents who preferred lean, medium and fat chops and the reasons for their preference, 56 per cent preferred the medium chop and of these respondents, 67 per cent gave "less fat" as their reason for selecting that chop. The authors suggest that it may have been difficult for the respondents to see that the lean chop was leaner than the medium chop and therefore had made their decision on the basis of colour and texture.

Diamant et al., (1975) examined consumer criteria for selecting pork chops from four different index groups. The hog carcasses were

Table 4

Number and Percentage of Respondents who Preferred  
Lean, Medium and Fat Chops and the  
Reasons for their Preferences

Reasons	Chop photograph preferred		
	Lean	Medium	Fat
Less fat	91	130	1
Need a little fat for flavour	10	25	11
More tenderloin or more meaty	8	15	9
Finer Texture	3	9	3
Other	1	11	5
Total	113	190	29
Proportion (percent)	33	56	8

(adapted from Gaarder et al., 1960)

indexed according to the Canadian hog carcass evaluation system described in a later section. Each respondent was shown a set of 4 loin chops and asked which one he/she would buy. A small amount of fat or least fat was the initial quality cited by a majority of respondents as influencing selection. After statistical analysis the total preference score for group I (the leanest chops) was significantly better than the scores for the other 3 groups. The consumers tended to select the chops from the highest index carcasses although over all indices, consumer behaviour was not clear cut.

#### Factors Influencing Sensory Qualities of Pork

Producers, retailers and consumers of meat, in general, are in agreement on the desirability of reducing fat content of carcasses to the minimum, on the basis of economy in production, selling and preference for lean meat. Since the demand is for leaner meat or less fat, the question arises whether a change toward leaner carcasses results in meat of less desirable sensory quality.

There is widespread belief that a certain amount of external and intramuscular fat is essential to ensure the best eating quality of the meat. Suggestions exist that leaner pork is less tender. Martin and Fredeen (1974) suggest lean pigs may produce less tender meat than fat pigs, and this is in agreement with the results reported by Batcher and Zeultan (1971).

Various researchers have looked at the effect of fat, extra and intramuscular on the eating quality of pork. Rhodes (1970) reported that a trained sensory panel can detect differences among longissimus dorsi

muscles of pigs in the sensory dimensions of texture, juiciness and overall acceptability, but these differences were not consistently related to fatness as determined by backfat thickness. The results from this study gave only a slight indication of any inferior eating qualities in the leaner roasts and suggests that selection programs for reducing fatness are in little danger of producing less acceptable meat.

Murphy and Carlin (1961) found that the amount of backfat on the carcass did not have a significant effect on the tenderness, juiciness, or flavour of braised chops. However, the sensory evaluation did reveal by the scores obtained, that sensory tenderness is closely related to sensory juiciness. It was reported that the lowest juiciness and lowest tenderness scores were given to pork chops from carcasses that had one inch of backfat whereas the highest juiciness and tenderness scores were given from carcasses that had 1.1 inches of backfat. Batcher and Dawson (1960) support the findings of Murphy and Carlin (1961) and reported that sensory panel tenderness and juiciness scores gave correlation coefficients of 0.48 and 0.40 respectively, with carcass backfat. Henning and co-workers (1973) were in agreement with Murphy and Carlin (1961) and Onate and Carlin (1967) showing that an increase in tenderness is associated with an increase in fatness. The Warner-Bratzler shear values in this particular study showed a nonsignificant quadratic effect between shear value and fattiness. Weir et al., (1962) found a positive relationship between fat content of pork chops and the sensory dimensions of tenderness and juiciness.

However, Heiner et al., (1965) reported relatively low correlations between backfat measurements and panel scores and also stated that back-

fat does not appear to be related to palatability. Heiner also states that the selection of swine for low backfat measurements and a high percentage of lean should not result in a reduction of acceptability of cooked chops. Skelley and co-workers (1971) are in agreement with Heiner et al., (1965) and report that panel scores and shear values for tenderness revealed no significant correlations with backfat.

It appears that there are many different and conflicting opinions on the effect of fat cover on the eating quality of pork.

Rust et al., (1972) have shown significant negative correlations ( $P < 0.05$ ) between loin weight and marbling, supporting the popular belief that meatier or more lean loins have less marbling. These heavier muscled loins were also found to be more tender ( $P < 0.01$ ) when subjected to tenderness evaluation of the Warner-Bratzler shear but not when evaluated by a sensory panel.

Fat is not only deposited around certain organs and under the skin but also within the muscles (marbling). Although marbling is not a factor in grading of pork in Canada, researchers have examined marbling as an indicator of pork eating quality.

For many years marbling was believed to be an indicator of desirable eating quality in meat, especially, tenderness. However, attempts to correlate objective measurements such as marbling score and percent ether extractable material in muscle tissue to panel scores or shear values have yielded highly variable results. Correlation coefficients reported have ranged from a low of  $-0.03$  to a high of  $0.86$  ( $P < 0.01$ ) (Paul and Palmer, 1970).

Other researchers (Blumer, 1963; Kauffman et al., 1964, Field,