Consumers' preferred

DEPARTMENT OF AGRICULTURAL MARKETING
UNIVERSITY OF NEWCASTLE UPON TYNE

a review of consumer attitudes and requirements for meat

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C O N T E N T S

INTRODUCTION

This review was undertaken at the request of the Meat and Livestock Commission, to examine the existing state of knowledge on consumer requirements for beef, lamb and pork, and to make some assessment of desirable future research. By far the most time consuming part of the work has been the assembly and consultation of reference material. While no one could claim to be able to run down all possible sources, we believe that nothing of special note has been missed. The work is confined to the three carcase meats in virtually unprocessed form, though it is obvious that processing could easily become more important in the future. In any event there is only a limited amount of published research on processed meat.

The format consists of an introductory chapter on meat in general, three chapters on each of the three main meats and a final section drawing some conclusions and making recommendations. The bibliography could have been presented in several different ways, though sorting according to subject of research would have led to much repetition since many projects deal with several facets of consumer preference. In the event therefore it is sectionalised to correspond with the composition of the four main chapters of the report. Therefore in its meat section there are included some references dealing more specifically with beef, lamb or pork.

CHAPTER 1

MEAT

Consumer studies have taken two distinctive approaches which have often been carried out as if in ignorance of each other or at best with only token recognition. Economists, including agricultural economists, have favoured an approach broadly described as demand analysis which has concentrated on the effects of price and income and family structure on consumption of "beef", or "lamb" or other aggregated commodity. There have been numerous attempts to expand these analyses. For example, Rhodes and Kiehl* presented a classical demand theory which recognised some of the basic characteristics such as lean and fat, influencing demand for the aggregate meat, and Lancaster** has presented a theory of demand in terms of product characteristics which would avoid the aggregate approach. Similarly constraints other than income have been incorporated into the economists model***. It is thus recognised that consumer behaviour patterns are more complex than those represented in most of their applied analysis but because of lack of convenient data or different purpose they are not explicitly modelled. It is worth noting that often when such models are empirically estimated using surveys of a cross section of consumers at a point in time only a small, perhaps 20%, of observed variation in consumer behaviour is explained. It can therefore be safely concluded that there must be other influential factors apart from income and family structure.

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* Rhodes, V.J. & Kiehl, E.R. (1956) On Consumer Grades for Foods. *J. Farm Econ.*, *38* : 44.

** Lancaster, K. (1966) Change and Innovation in the Technology of Consumption. *Am.Econ.Rev.*

*** For example: Dusenburg, J.J. , Income, Savings, and for the theory of Consumer Demand, and Prochaska, F.J. & Schrimper, R.A. Opportunity Cost of Time and other Socio-Economic Effects on Away-from-Home Food Consumption. *Am.J.Ag.Econ. 55* : 595.

The alternative approach is less aggregated, concentrating on consumer requirements or attitudes to specific characteristics of meat, frequently ignoring price and possibly income. This review concentrates on such studies, but does not attempt to include those reports which relate requirements and attitudes to carcase characteristics.

The earliest study included in the bibliography dates from 1912 (70) and there are several early studes (1, 23). Bratzler (12) and Naumann *et al* (38) have noticed however there was little research prior to 1959 and that the real momentum came during the 1950's, particularly in the U.S.A.

Any study of requirements and attitudes must presuppose a theory or model of demand or consumer behaviour. Much of modern demand analysis suggests a hierarchy of events leading to consumption of a particular product. In its simplest presentation this would separate the action into three components:

(1) a need or desire to consume meat;

(2) the actual purchase of the meat; and

(3) the eating of the meat.

Consideration of the need for meat involves the socio-psychological qualities of meat or attitude to meat where attitude is defined as "a pre-disposition to behave in a particular manner" (32). The actual purchase of meat involves both attitudes and physical requirements because the former influences choice of shop and type of meat and the latter are used as an indication of the likely physical characteristics on eating. Consideration of consumption of the meat involves consumer perception of the physical characteristics of meat.

The majority of reports included in the review fall in the latter two categories and are frequently referred to as requirement studies as opposed to attitude studies. Consumer requirements at eating and on purchase are partially reflected in the controversy about the concepts of consumer preference and consumer acceptability. Rhodes (41) defines preference as the selection of particular product as the most desirable of two or more alternatives in a given situation. Acceptability refers to the saleability of the product in a given market situation or the extent to which it will be consumed in a given eating situation. Thus an individual might be able to say which two meats he prefers but would not be prepared to distinguish between them when shopping and might not buy any of either. The acceptability type of study is therefore much less limited than a preference study and is likely to involve some kind of real or stimulated shopping situation.

The difficulty of measuring consumer attitudes and requirements has often been noted (31, 41, 7). The two main methods of assessment are the laboratory panel and the consumer panel or survey. With the laboratory panel a small group of individuals selected for their known ability to discriminate between foods under controlled laboratory conditions is required to indicate a preference on the basis of various characteristics (30, 31). "The inference of expert preferences to the great mass of consumers required a heroic assumption about the representativeness of experts. However the method has often been used because of its convenience and susceptibility to rigid control." (31).

There are two dangers implicit in the laboratory panel. Firstly that the nature of their preferences may be non-representative. Although successful use of laboratory panels has been reported for predicting mass acceptance of meat (39) numerous studies cast serious doubt on the procedure (37, 68, 89, 85). For example, Rhodes & Kiehl (85) observed only a weak correlation between consumer and laboratory panel acceptance of Beef Loin Steaks and Schupp (89) presents results where a 400 member consumer panel fails to detect differences in tenderness, flavour, and overall desirability which a laboratory panel define. Even when a stronger correlation between laboratory and consumer panel is observed (86) this reaches only 0.69 for tenderness and is much lower for other characteristics. Moreover, there are numerous studies which illustrate the effect of real world factors on discriminating abilities such as brand name or amount of information about the meat (5, 11, 34, 35) and which are likely to conceal differences perceived under controlled laboratory conditions. For this reason the present review is restricted to non-laboratory panel studies unless they are of special interest.

Consumer panels or surveys are distinguished from laboratory panels in that their selection procedure allows them to be representative of the population. Unfortunately, both requirement and attitude surveys are expensive. As one consequence they have tended to use very localised groups of families. Reference to the bibliography will produce many examples of consumer panels or surveys carried out in one town or a single region (e.g. 1, 7, 9, 26, 27, 33, 49, 72, 103, 130). A few notable exceptions to this are provided by Brayshaw *et al* (14) and British Cellophane (16) in the U.K. and by Weidenhamer *et al* (47) and Anon. (97) in the U.S.A. Given the wide discrepancy in general meat eating patterns in the U.K.* and even for branded meat products (3) the representativeness of such localised surveys may be less than hoped for.

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* See, for example, the annual reports of the National Food Survey on Household Food Consumption & Expenditure (HMSO).

Attitudes to Meat

The place or relative position of meat within overall consumption patterns appears to have received little study apart from its relationship to consumers' income. The British Market Research Bureau Menu Survey (10) does record some features and changes in meal patterns, such as the preponderance of roasts in Sunday meals and of snack-type meals on other days. Indeed this distinction has been reflected in a number of studies which contrast the requirements of Sunday and mid-week meals (21, 26, 28).

Hughes (28) records in his survey that for Sunday lunch at least 95% of all housewives, children and husbands eat meat. On the remaining days a much smaller proportion may eat a meat-based meal at lunchtime. He also notes that "Although the level of meat consumption was generally low, the housewives believed that their husbands needed the nourishment of more meat meals than they did themselves. The husbands, therefore, averaged about 10% more meat-based meals than did their wives. Children were placed midway between their parents for frequency of meat meal consumption".

The study by Baron *et al* (7) investigated housewives' attitudes to food and cooking. They identify 4 major factors for these attitudes.

Major Factors for Attitudes to Food and Cooking

Factors	Loading	Mean Score	Attitude to
About the only way to get good meat is to find a good butcher and stick to him	0.82350	5.4	
I like to buy my meat where people know me	0.72424	5.2	
Supermarket meat is not as good as traditional butchers	0.56048	5.0	Butcher
Meat is necessary for a good diet	0.68659	5.8	Meat Importance
Meat is the basis of a meal	0.67207	5.8	
I try to vary the meat we have	0.66901	5.7	
I like to try something different occasionally	0.64361	5.6	Experimenting
You can never be sure how a piece of meat will turn out	0.59326	4.5	
The trouble with a joint is the time it takes to cook	0.44475	3.6	Confidence

Source: Baron *et al* (7), Table IX

The two notable factors were the importance of meat to a meal and experimenting; the need for variety.

Only one study by Hughes (28) has been observed which explicitly recognises that meat is nutritionally but one way of supplying protein. He compared meat with cheese and eggs as alternative sources of protein and found that housewives thought meat an essential part of the main meal of the day. This agrees with the report of Tretheny (45) prepared for the Verdon-Smith Committee. He further shows that housewives believe that other protein sources lack "substantiality" and "versatility". There was some evidence that they thought the other protein sources less nutritious.

In some respects even the definition of meat is imprecise. Poultry in the U.K. illustrate this clearly. As a source of animal protein it would fit a dictionary definition of meat. Many, particularly earlier, studies of meat, however, do not include poultry (e.g. 36). Indeed, housewives when questioned about meat in the U.K., often list chicken as a separate item to meat or fail to include it as a meat. Hughes (28) concluded from Word Association and Unfinished Sentence tests ".... that in many cases when the housewife thinks of meat it is beef she has in mind". There is nevertheless strong evidence that chicken should be included as a meat category. In Hughes' study it is listed with lamb as the second most frequently consumed at the week-end meal, Sunday lunch, and in terms of national consumption it is, with pork, second only to beef*. More recent studies of price/quantity relationships also shows significant cross elasticities at least for lamb and chicken**.

A broad indication of preference is indicated by changes in relative consumption levels for different kinds of meat over time. The graph (p.12) indicates changes in the U.K. and again illustrates the present day importance of chicken and of mixed or processed meats. Of course it is validly argued that a large part of such changes have come about because of changes in price relativities. Two results, however, indicate that there are more fundamental changes in preferences.

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* Food Facts. Min. of Agric.Fish. and Food, Aug. 30, 1973.

** Edwards, D.R. & Philpott, B.P. Supply and Demand Projections of the UK Meat Market in 1973. Res.Rep.No.57, Lincoln College, N.Z., 1969, and National Food Survey, *op.cit.*

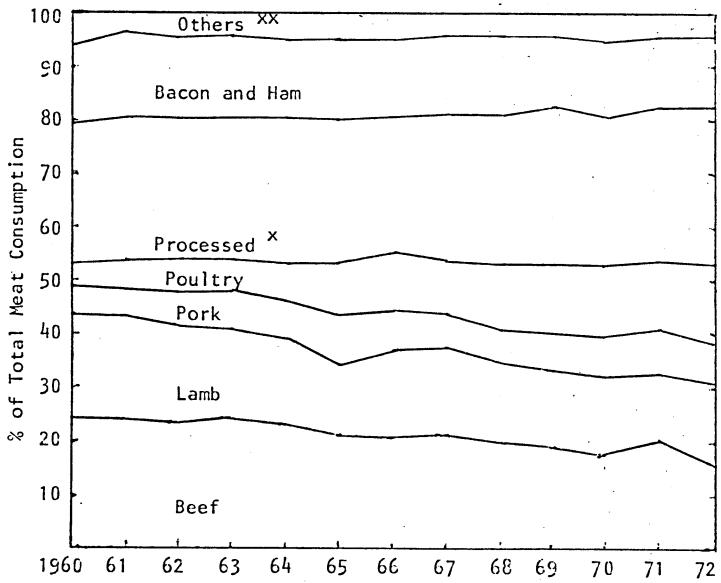
Household Consumption of Meat (by meat type) over the two Survey Periods

Midday Meal

%	Mother		Children		Husband	
	Weekday	Sunday	Weekday	Sunday	Weekday	Sunday
Beef	20.7	31.0	20.8	28.4	21.9	30.2
Pork	5.4	1.4	4.2	15.4	6.5	15.1
Bacon	8.6	1.2	6.9	1.2	8.9	0.7
Lamb	7.4	24.8	6.1	23.5	7.3	24.8
Poultry	6.6	23.2	6.4	26.2	6.8	24.0
Meat unspecified	5.2	1.6	4.7	1.9	5.8	1.2
Processed meat	10.4	1.8	11.8	1.3	7.9	1.5
Meat pies	20.4	1.8	20.9	0.9	19.6	2.0
Sausages	10.5	0.2	14.3	0.8	10.2	0.1
Liver	4.8	0.4	4.1	0.5	5.2	0.5
Total	100	100	100	100	100	100

Source: Hughes (28), Table 35.

Patterns of G.B. Meat Consumption



x Includes bones, offals, game.

xx Cooked and Canned Meat, Quick Frozen Meat (except poultry), pies, sausages, etc.

Source: National Food Survey, *op.cit.*

The National Food Survey* indicates increasing strength of demand for poultry and pork after the effect of price and income are removed. Secondly the Gallup Survey on the Ideal Meat (4) which asks consumers to indicate a preferred menu irrespective of price produces the results:

	1947	1973
% Preferring Chicken	22	9
Steak	9	43

This again illustrates the changing place of chicken from a luxury to everyday item. The figures for 1973 are substantially the same as those produced by Hughes (28).

It would seem therefore that in the U.K., in practice at least, chicken has become another meat, competes for the consumer's attention, and can be considered in a comparative attitudinal framework. Although it is not thought of immediately when housewives are questioned informally it is included when a structured questionnaire or the force of a buying situation is imposed.

When individual meats are considered it is interesting to compare their popularity in different countries.

Order of Preference for Different Meats

	U.S.A.	New Zealand	U.K.
Town:	Columbia, Missouri	Christchurch	Leeds
Date:	1953	1965	1957
Sample:	361	322	922
Beef	1	Lamb 1	Beef 1
Pork	2	Beef 2	No Preference 2
No Preference	3	Pork 3	Lamb 3
Poultry)	4	Poultry 4	Pork 4
Lamb)		Mutton 5	
Veal	6	Ham 6	
		Bacon 7	
	Source: 110	Source: 49	Source: 36

* National Food Survey, *op.cit.*

To assess attitudes to meat, consumers or housewives are questioned with varying degrees of structure about their thoughts and rationalisation of their behaviour. When unstructured their responses most frequently centre on statements about quality and nourishment or nutrition. Thus Yandle (49) lists quality as the most important criteria influencing housewives' preferences in Christchurch, New Zealand. Similar statements are found elsewhere (9, 23).

Interestingly, Hughes (28) reports that his enquiries indicated some housewives thought protein sources other than meat to be less nutritious. This is obviously an important reason for eating meat and is widely reported in studies offering respondents free choice answers on the selection of meat (21, 26, 7, 28, 29). Some apparently are substantially influenced by their beliefs which influence usage patterns. It has been reported that the preference for beef in Argentina results partly from lack of information about the nutritional content of its substitutes. Even in the U.K. and U.S.A. housewives apparently believe beef to be more nutritious than other meats (7, 47)..

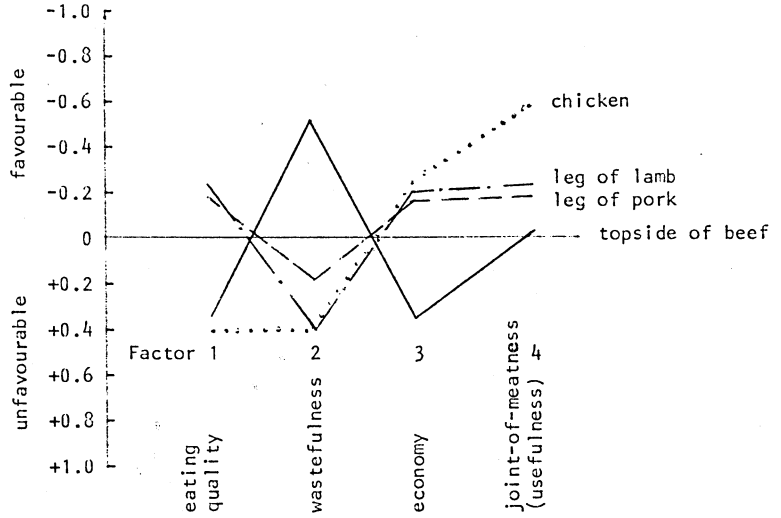
Neither nutritious or quality show an unambigous interpretation and most studies attempt to clarify their meaning. Most studies express them in terms of physical characteristics such as tenderness or leanness and will be considered separately for each meat. It is worth noting however that a few studies have attempted a more general attitudinal approach and to compare meats.

Baron *et al* (7), Hughes (29) in the U.K. and Weidenhamer *et al* (47) in the U.S.A. have all attempted to assess and compare attitudes to different meats using bi-polar scales - on which respondents are asked to indicate their feelings about meats. All three studies tend to combine attitude to the product and to its purchase.

Baron *et al* list important attitudes, not necessarily in order of importance, as appetisingness, nutritiousness, amount and edibility of fat, digestibility, economy, versatility, taste, tenderness, modern-ness, re-use, and a supermarket buy. These are reproduced in a somewhat combined manner in Hughes and Weidenhamer *et al*, while broadly similar, includes tiresomeness and keeping quality. Actual opinions on these factors are strikingly similar in the U.K. and U.S.A. Beef scores well on most factors except economy; Pork ranks well except for digestibility and fattiness; Poultry does well except for nutrition, taste, and tiresome in the U.S.A.; Lamb does least well on most factors except economy in U.K. and in the U.S.A. there is a substantial number expressing a dislike for its flavour or odour.

Hughes identifies a smaller number of factors but is especially interesting in that the results are presented graphically. Illustrated below are the results for four week-end type meats which show clearly the differences between meats.

TRELLIS OF MEAN FACTOR SCORES FOR THREE WEEKEND CUTS OF MEAT



Source: Hughes (29), Figs. 1 and 4.

There are problems in translating such studies directly into suggestions about behaviour because there are important influences even outside the shop. Attitudes are influenced by knowledge of country of origin. It has been recorded that consumers in U.K. consider Argentine meat inferior (2) and in general prefer domestic supplies (36) and studies have been made of consumer/wholesaler attitudes to Scottish meat (35) and both Scottish and other imported meat in France and Germany (6). Knowledge of meat content is believed to be important for processed products and is controlled in tasting experiments (5). Similarly the influence of advertising and subsequent brand images may seriously affect consumer taste panels' (34) judgement of turkey meat.

The persistence of basic attitudes must however be noted. Grunewald (24) expresses this well when she notes that despite many years of heavy advertising consumers' attitudes to pork have

not been altered in Italy. Hunter *et al* (102) have similarly shown that advertising has little effect on home-makers' attitudes to lamb. Hughes (29) again provides the only example of a direct attempt to quantify the impact of attitudes on consumption. Unfortunately his survey data only permits a weak test, failing for example to record income or allow for the need to vary diets. Within these limits he suggests attitudes do influence consumption but are less important than socio-economic characteristics.

Attitudes and Requirements at Point of Purchase

Behaviour is also influenced by the nature of the purchasing environment. Indeed Hudson and Danner (27) report that 70% of interviewees thought most people waited until they got to the store before making meat buying decisions, and there are a number of studies in this area. The bulk of these relate to customer requirements of the meat itself and concentrate on leanness, colour of lean and fat, marbling, size of cut or eye of chop, appearance of bone and quantity present and freshness (8, 13, 20, 36, 44). It is sensible to consider these specific attributes separately for each meat except for freshness. Freshness is a requirement which is easily overlooked in temperate climates and developed economies. It has, however, been reported as one of the most important characteristics influencing choice in Mexico (17) and as a reason for not buying ready-frozen meat in the U.S.A. (47). Barton (53) similarly notes that Italians suspect frozen meat because this is the treatment for cattle infected with beef measles, thus limiting sales.

Another substantial area of research concerns the method of retail sale; in particular the difference between conventional and self service. Brayshaw and Perkins (13) in the U.K. have shown customers to prefer personal service, require convenient location of meat shops, and freshness of purchases. The latter requires refrigeration and is doubted when meat is prepacked. A part of the doubt concerning freshness is considered to originate from the inability to see both sides of prepacked meat. Other workers in the U.K. (16) and in the U.S.A. (43) have arrived at similar conclusions.

Other conditions are important. American studies frequently list the effect of advertising (27) and several authors have noted the butcher's influence (27, 45). The butcher's influence is not however easy to isolate and a number of explanations have been offered. Only the study by Carpenter *et al* (18) appears to consider this in any depth. Here it was shown that "variation between shops in eating quality of the meat they sell is too small and unsystematic to be statistically significant, yet housewives discriminate significantly between butchers for meat quality".

Leanness and price of lamb chops were the only factors to match consumer quality perceptions. Lesser (32) has gone further to suggest that housewives judge meat quality by the image projected by the butcher.

Eating Requirements

When it comes to eating requirements the characteristics are primarily physical. These have been widely studied and include tenderness, flavour, juiciness and aroma (40, 48). Again the specific characteristics are discussed later for each meat. It may be noted that because the characteristics are based on subjective evaluation there has been controversy over their measurement. Only tenderness has yielded, and then only partiallly, to objective measurement, usually by means of a mechanical shear method.

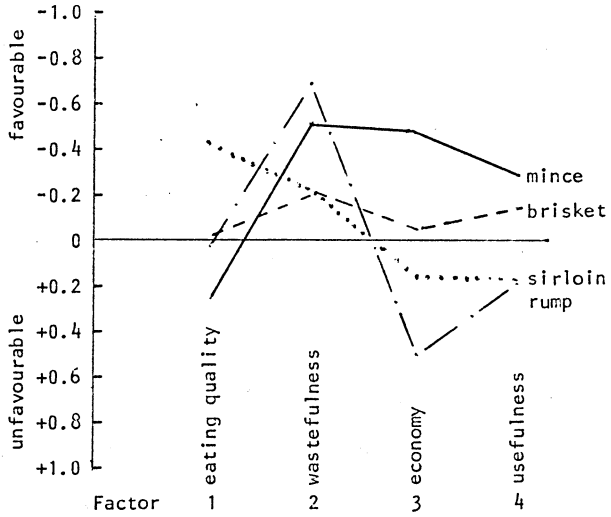
A complicating factor when using consumer panels or surveys is the method of cooking. Although this factor has been commented on in individual studies the only large scale survey appears to be that by Weidenhamer *et al* (47) in the U.S.A. Housewives were asked at what oven temperature they prepared lamb, ham and pork, giving the following results:

Oven temperature when roasting	Lamb	Ham	Pork
		%	
275 degrees or less	3	6	4
300 to 325 degrees	30	32	30
350 to 375 degrees	50	49	49
400 degrees or more	5	5	7
Don't know, no answer	12	8	10
No. Respondents roasting meat:	697	2366	1894

Source: Weidenhamer *et al* (47), p.13.

Finally, there remain a number of additional qualifications to the research into requirements and attitudes for meat. Nearly all of the studies considered so far have concerned prime carcase joints. There are relatively few published studies relating to either poultry or processed and cheaper cuts of other meat. These are however very important consumption groups. Weidenhamer *et al* (47), for example, reports ground beef as being served more frequently than any other cut of beef. Baron *et al* (7)similarly report expenditure on mince at 8.1% of total meat expenditure to be exceeded only by chicken, lamb chops, beef steak, and beef joint. Again Hughes (29) is the only author to compare a wide range of differing cuts of a particular meat and then only with respect to attitudes. His attitude scores for different cuts of beef show considerable variation from one cut to another.

TRELLIS OF MEAN FACTOR SCORES FOR CUTS OF BEEF



Source: Hughes (29), Figs. 2, 3 and 4.

Beef has received by far the largest share of attention with respect to consumer preference studies. Thus there are 46 references on beef as opposed to only 14 on lamb and 20 on pork in this survey, or a ratio of 5.8/1.7/2.5. Given the relative importance of beef consumption, particularly in the U.S.A., this is perhaps to be expected. It is worth noting however that in terms of carcase consumption the ratio in U.S.A. is 6.4/0.2/3.4 and U.K. 4.8/2.5/2.5 yet it is the strenuous efforts of the American Sheep Breeders Council which has generated a large number of the lamb studies.

CHAPTER 2

BEEF

It may be less realistic to attempt to identify consumer requirements for beef than for any other category of carcase meat, because the range of different cuts is greater and their possible culinary uses more numerous. Thus it is impossible to know, for example, whether an attitude to or desired characteristic for "beef" relates to rump steak or shin, or some half understood combination of several different cuts. Indeed, there is ample evidence, (14, 28, 76) that the average housewife has only very limited knowledge of the many different cuts of beef which exist, and appears to be bewildered by the range available. While research into desired characteristics is usually undertaken by reference to some specific sample cut, thus raising the question how far the findings can be inferred to other cuts, attitudes have initially been explored in relation to principal meat categories such as beef, lamb and pork, the problem then being to know to which specific cuts, if any, they relate.

Nevertheless most would find some meaning in the findings of Baron *et al* (7) that Beef is thought the most nourishing and appetising meat and has the greatest potential for re-use in a second meal. It is least wasteful and has least fat. Indeed beef fat, hor or cold, is preferred to any other sort of fat. Although not the tenderest meat it is considered easy to carve and very digestible. However it is thought the most expensive meat and is not considered to be very thrifty.

Again Weidenhamer *et al* (47) have shown that more housewives in Philadelphia identify with favourable statements about beef than about chicken, ham or pork, and fewer with unfavourable statements about beef than about the other three meats. Out of 14 different statements, such as "sure of good quality", "tasty", "not too much waste", and "don't get tired of", only one "good to eat cold" was mentioned more often for chicken and ham but not for pork. On average beef drew about 8 of the possible 14 favourable comments from each housewife while fresh pork drew only 3 of the 14. Notably beef received 71 favourable mentions for "many different ways to cook" and only 3 unfavourable mentions on this count, compared with 27 favourable and 20 unfavourable for pork.

Part of this high degree of versatility which housewives attributed to beef was taken to derive from the number of different forms in which it is available. Thus the majority of housewives considered ground beef inexpensive, easy to prepare and, together with steak, good to serve in warm weather. They also thought that

roasts were prestigious and a good choice for entertaining when guests' preferences were unknown.

Hughes (29) in a more rigorous study of attitudes to certain week-end and mid-week cuts derived four composite attitudinal factors from a number of basic attitudes; these were "eating quality", "wastefulness", "economy" and "usefulness". His results demonstrate that, though "beef" may hold an image which is generally favourable, no single week-end or mid-week cut of beef, except stewing steak, scores favourably on every factor. Thus topside scored badly for "eating quality" and "economy", moderately for "usefulness", and well for "lack of waste"; stewing steak scored well to "lack of waste" and "economy" but moderately for "eating quality" and "usefulness". His results for mince showed similarly favourable attitudes for those found by Weidenhamer, but also an unfavourable attitude as far as "eating quality" was concerned. Brisket, though not very highly thought of on any count, received a marginally unfavourable score on one attribute only; that of "eating quality". Rump steak, though obtaining the highest score of all meats for "lack of waste", scored unfavourably on all three other factors.

Hughes' (29) conclusion that the meat trade should try either to revamp the images of meat cuts, or attempt to tailor make products to fit consumer requirements is as well argued for beef as for other meats. Nevertheless there is some evidence from this enquiry and from the work of Butterworth *et al* (17) that many beef cuts are regarded as superior to those from other meats. In the latter study beef cuts were mentioned 92% of first choice of cuts, 81% of second and 70.2% of third choices.

One other well known attitude deserves mention; the strong aversion of many consumers to frozen beef. Weidenhamer *et al* (47) obtained the following answers to the question "Would you or would you not like to buy any raw meat already frozen - where you usually buy meat, not from a freezer plan?"

	%
No I would not	79
Yes I would	13
It depends	6
I already buy frozen meat	1

In selecting beef in the shop consumers presumably have some idea of eating satisfaction in mind, though they may also derive some independent satisfaction from the purchase itself.

Nevertheless, it is known that in most cases buyers are unable to make accurate estimates of eating quality at the time of purchase. Lasley *et al* (73) and Rhodes *et al* (83) showed that visual preferences for beef did not correlate with preferences on eating and Brayshaw *et al* (14) found that a high proportion of customers left the choice of their beef to the butcher.

Rhodes *et al* (83) questioned respondents on their preferences regarding generally accepted visually identifiable characteristics of steaks and roasts. Those were, amount of external fat, amount of marbling, colour of lean, colour of fat, amount of bone, texture, and "gobs of internal fat". Their results showed that the order in importance of preferences for the various attributes of roasts as influences upon the overall preferences was (1) amount of internal fat, (2) colour of lean, (3) amount of marbling, (4) amount of external fat, (5) colour of fat, (6) amount of bone. The order of importance of the attributes of steaks was (1) amount of external fat, (2) colour of lean, (3) marbling, (4) texture, (5) colour of fat, (6) amount of bone.

There is general agreement among most research workers, 17, 62, 63, 64, 83, and others that consumers prefer beef roasts and steaks with only a limited amount of fat. In the U.K. Brayshaw *et al* (63) estimated that not more than fifteen per cent of consumers are likely to require sirloin steaks with more than approximately 30% of visible fat. This compares with Branson's (59) finding that 27% of respondents liked a large amount of fat.

A shop test by Carpenter *et al* (64) has shown that customers are prepared to pay a considerable premium for steaks with 13% as opposed to 30% visible fat. Using their data to construct a ratio of elasticity

$$\frac{\%\text{ change in sales ratio of lean to fat steaks}}{\%\text{ change in price ratio of lean to fat steaks}}$$

a figure of -0.24 is obtained indicating a great reluctance to switch from lean to fatter steaks. In the U.S.A. preferences have been often related to U.S. grades which might be made to yield more such qualitative estimates of most desired levels of leanness.

Again there is some agreement among various workers that consumers are not greatly disturbed by the absence of marbling. Brayshaw *et al* (14) found that butchers did not believe that their customers considered marbling in making their choices, and, since very little marbled beef would have been available this may amount to a dispreference and thus agree with Branson (59) who states that only 1 out of 7 families in

Houston preferred a large amount of marbling, 2 a medium amount and 4 very little if any. In fact the tendency of consumers to discount marbling as a criterion of selection seems to be justified by Blumer's (57) careful analysis of published work dealing with the relationship of marbling to palatability.

Several workers identify bright red as the colour of lean most desired. Branson (59) states that this was the most important characteristic sought when buying beef. Rhodes *et al* (83) found colour of lean somewhat less important in consumer choice, and made no assessment of the actual colour required. In a study of discolouration in prepacked beef, however, Hood and Riordan (71) found a linear relationshio between the level of discolouration and the proportion of total sales of discoloured beef over a range of 5-33% metmyoglobin. The ratio of sales of discoloured beef to bright red beef was approximately 1 : 2 when 20% metmyoglobin was present in the discoloured batch. Puig *et al* (82) however suggest that, while consumers prefer very light red or light red steaks, it is possible for steaks to be too light in colour to find favour with consumers.

More variation in desired fat colour is perhaps predictable, since this appears to be related to no small extent to experience. Thus Butterworth *et al* (17) found 51% preference for white fat rather than medium yellow (36%) or yellow (13%). Barton (54) quotes Ashby *et al* (52) to show again that about 35% of consumers preferred yellowish fat to white fat. There appears however to have been less precise measurement of pigmentation in studying preference for fat colouration than for that of lean, which may explain the common if imprecise assumption that preference is mainly for white or creamy white colour in fat.

We have been unable to find much definitive work on consumer tolerance regarding proportion of bone. Rhodes *et al* (83) show that only about a quarter of their respondents gave evidence that amount of bone may have influenced their overall preference for beef roasts, and that amount of bone contributed only 7.2% of the explained variance of overall rating of steaks. With steaks respondents barely discriminated between four U.S. grades for amount of bone, and for roasts only slightly more so. Campbell (62) found that small amount of bone accounted for 17.8% of all first reasons for selecting roasts from the three U.S. grades Choice, Good and Commercial. Thus one can conclude that bone is a significant influence on selection, though by no means the most important, but without any evidence of the degree of toleration between joints with different proportions of bone.

There thus emerges from numerous sources a reasonably consistent picture of the type of beef which the majority of consumers will require at time of purchase. It will have little internal fat whether marbled or otherwise, minimal fat cover of a white or creamy white colour, bright red lean, and not too much bone. Besides, thickness and texture may be relevant criteria. Neither appear to have been much researched, but Barton (54) suggests that decline in beef consumption in Australia may be partly influenced by the thinness of retail cut steaks.

It is notable however that for almost every characteristic, except amount of bone there are significant proportions of consumers whose requirements differ from those of the majority. As will be shown in the next section, these requirements do not appear to vary according to common segmentational characteristics such as socio economic class, little is known about the characteristics of consumers who, for example, require more fat or darker meat, except that they appear to be influenced by area as in France (Anon. 50).

Consumer requirements for beef on eating have been examined by many workers, and a high degree of agreement can be found in their results. A possible explanation of this unanimity may be that the greater part of such tests have been undertaken using steaks often from the loin; a cut most likely to have widespread and even international criteria of assessment. There are some studies with roasts and we have noted that Barton (53) quotes a U.S. study which shows preference for ground beef containing about 20% high quality fat.

Characteristics considered have included tenderness, flavour, odour, succulence, juiciness, leanness, texture and freshness. Most workers, however, have somewhat curtailed the list of criteria for assessment. Thus, Kiehl *et al* (72) obtained the following percentages of characteristics considered most important by respondents in cooked steaks; freshness 50.5; tenderness 29.0; flavour 18.2; and juiciness 2.3. Freshness and juiciness may be difficult to dissociate from flavour and tenderness when assessing the eating satisfaction from beef, as indeed may texture. There is much to be said therefore for Brayshaw *et al* (63) study which confined attention to tenderness and flavour but also included fattiness. Their conclusion nevertheless still makes tenderness the most important characteristic, followed by leanness, with flavour of very little importance.

Respondents who thought the beef had a strong flavour preferred the meat more than if they thought the flavour was slight. Nevertheless, consumers were unable, on average, to distinguish between the flavour of barley beef and meat from

more mature animals, and consequently showed no preference for one or the other. The authors had the impression, however, that perhaps 25% of consumers could distinguish flavour differences and would then choose the stronger flavoured beef. Similarly Epley *et al* (68) comparing steaks from differently produced beef obtained significantly ($P < .05$) different flavour intensity scores from a taste panel but failed to reproduce these with a consumer survey.

By contrast, when fattiness was considered Brayshaw *et al* (63) showed that consumers were able to distinguish between steaks with fat contents differing by as little as 4 or 5 per cent, and to have significant preferences for the leaner steaks when these differed by about 16%. Moreover very little fat from the leaner steaks was left on the plate while a relatively large proportion of those who consumed the fattier steaks discarded a lot of fat.

Tenderness was measured in the same study, as in many others, with the Warner Bratzler shear. The range was from very tender steaks with shear values of 14 lbs to very tough meat with shear values of 32 lbs. While consumers could generally detect differences in tenderness reflected by variations in shear value of 5 lbs or more, and on average preferred the more tender steaks throughout the range, those with shear values of up to 22 lbs were considered very tender by more than 50% of the sample and were liked, at least moderately, by 76%. Rhodes *et al* (85) suggest a very similar shear value of 20 lbs as the dividing line between acceptably tender and unacceptably tough sirloins, while Naumann *et al* (79) found that steaks with low mean acceptance ratings had shear values generally higher than 8 lbs. Brayshaw *et al* (63), while noting a considerable range of tenderness as being acceptable, nevertheless underline the fact that this characteristic is associated more with overall eating acceptability than any other quality characteristic.

We have been unable to find much useful information on succulence, odour or texture, doubtless because of the difficulty of objective measurement of these constituent items of more widely comprehended characteristics such as tenderness and flavour. Woodhams and Trower (94) in comparing, in laboratory tests, bull and steer beef, however, failed to obtain significantly different scores for aroma or juiciness, as indeed they also failed to do for flavour. Barton (54) treats flavour and odour as almost synonymous and suggests that while American consumers appear to like beef with a bland flavour, New Zealanders prefer a stronger almost mutton-like flavour in their beef.

McHugh *et al* (77) in a small survey concerned with tenderized round steaks failed to find any notable difference in consumer

acceptance for juiciness between these and untenderized steaks. Rhodes *et al* (83) asked the admittedly ambiguous question of consumers in Missouri, what degree of juiciness do you most prefer in steak or roast. Their results therefore only show that some degree of juiciness is desired by about three-quarters of respondents for both steaks and roasts. Texture appears to have been the subject of only a few laboratory tests from which very little can be deduced.

For practical purposes the foregoing discussion is probably best summed up by Brayshaw *et al* (63) when they say that their results confirm that quality characteristics of steaks can vary within quite broad limits and still result in a reasonable degree of satisfaction for the consumer, but that nevertheless a broad picture of a generally acceptable frying steak can be drawn. It should be above all tender, with a Warner Bratzler shear value of less than 22 lbs; it should have a visible fat content of between twenty and thirty per cent; and though most consumers are unlikely to detect quite marked differences, they should probably believe that it has a strong beef flavour.

Virtually all the published research dealing with requirement characteristics whether at time of purchase or on eating either consciously, as in the case of the Newcastle research, or apparently unconsciously in most other cases attempts to examine mass market requirements. Often however resulting data is examined for possible differences between socio economic classes, 63, 85, 83, 59 and others. Most of such comparisons are of limited significance because of the inevitable bias resulting from disaggregating relatively small samples. Most of these surveys find small differences between socio economic classes in their acceptance of some characteristics, but in general nothing of much practical application. Thus Brayshaw *et al* (63) conclude that preferences do not differ significantly between socio economic classes A, B, C and D. The same conclusion was reached when comparing data from cities as widely distributed as Glasgow, Newcastle, London and Birmingham, though Glasgow respondents were found to discriminate at a higher level than those in other cities. Rhodes *et al* (83) state that no strong socio economic relationships to preferences were found. In another report, however, Rhodes *et al* (85) do point to differences in consumer acceptance between younger and older housewives, between housewives with fewer and more years of formal education, and note that income of male respondents was a very significant influence. Nevertheless they admit that these results may be biased.

Cooking methos as they influence acceptance have also been examined by Rhodes *et al* (85), Bramblett and Varl (58) and Brayshaw *et al* (63) with no very conclusive results, but a suggestion that these have little affect on preference.

CHAPTER 3

LAMB

There are a relatively large number of studies relating to lamb which consider consumer attitudes compared to those considering requirements on shopping or eating. This probably follows from the low and decreasing consumption levels in most areas outside the U.K. and Australasia. Thus there is a serious concern to study why lamb is not consumed (97). Even in the U.K. the strength of demand for lamb appears to be declining and a similar concern has emerged (7, 109).

Only in the survey by Yandle (49) in Christchurch, New Zealand do consumers list lamb as their most preferred meat. Marsh's study in Leeds in 1958 listed it second to beef. More recent studies in the U.K. (7, 29) conclude that lamb was thrifty, tender, digestible, but the least appetising of beef, lamb, pork and poultry; fatty, unpleasant cold, lacking versatility and difficult to carve. The American Sheep Producers Council study of 1964 (97) reported that lamb's image is ".... characterised as being easy to digest, high in protein, tender and good for young and old alike. Respondents considered lamb to be tender, although when asked to compare it with other meats they rated lamb less tender than beef, veal, pork or chicken. Some persons have the impression that lamb is a meat that persons become tired of, and others have the impression that it is expensive .... many persons .... have the impression that lamb is not a versatile meat in terms of variety of preparation and cuts and when it can be served". The second major American study Weidenhamer *et al* (47) produced similar results and apart from the reversed image with respect to expensiveness are strikingly similar to the U.K. study.

Several American studies note in addition that lamb consumers are likely to be of English speaking origin (96, 97). Both U.K. studies (7) and American (47, 97) suggest regular users are likely to be in older age groups. A particular interest to American studies concerns the taste or odour peculiar to lamb. While regular lamb users may suggest this as a reason for consumption in the American Sheep Producers Council study (97) 56% of respondents listed taste or odour as a reason for not using lamb. Similar results were obtained in other studies (47, 96, 102, 107) and Barton (100) notes that this is considered of significance to many consumers in Japan also. The greasy nature of lamb fat was another disadvantage reported by 27% of non-users in the Sheep Producers Council study. In Baron *et al* (7) lamb is ranked second to pork for greasiness of fat. Another frequently

mentioned reason in all American studies is lack of exposure as children, or lack of knowledge on how to prepare or use. Despite this, however, Avery (98) is able to report that teenage girls do not have an aversion to the product but rather they have an open mind regarding lamb. Carmen (101) summarises the position in the statement that "....U.S. consumers consider lamb to be expensive, but not a prestige meat, difficult to prepare and undesirable to serve to guests, especially if their preferences are not known".

Studies from other countries are less detailed. Two recent reports (6, 46) have considered French consumer attitudes and report ".... mutton and lamb is tender, tasty, and is highly regarded". Along with veal it is considered a "de luxe" meat. It is expensive and regular consumption is reserved for 'high bracket households'. The main reproach for cuts other than leg of lamb is that they are too fat. They are consumed in regional or exotic dishes for taste improvement and prestige. Throughout the EEC countries fat lamb was to be avoided. Another country showing substantially increased consumption of lamb is Japan and, although it is known that attitude studies have been carried out they are not published.*

Selection of lamb in the store is based mainly on colour of lean and of fat, and leanness, but many depend on the butcher's selection (97).

For the American market it is suggested that "quality lamb has a firm dry surface, modest marbling, and a bright red colour, that is slightly darker than beef. A dark muscle colour and a yellow fat colour both suggest mutton-like properties and therefore are discriminated against as detrimental fresh meat traits in lamb" (40). Such statements lack a precise definition of desirable levels of the listed characteristics. They are not backed by published consumer tests and must be presumed to be based on private tests or informal opinion.

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*N.Z. Meat Producers' Board. Annual Rept. and Statement of Accounts for year ending September 30th, 1971, p. 47.

Criteria Used for Selecting Good Lamb

Characteristics	Total Users (%)
Should be pink or red	36.2
Should be lean	34.3
Should be light, medium or bright colour	24.8
Depend upon butcher	20.3
Appearance	18.2
Colour of fat	11.2
Width of fat	9.0
Amount of bone, gristle or waste	8.6
Size of thickness	7.9
Texture-firm fat	6.6
Colour - unspecified	5.5
All other colour	5.0
Smells good	3.8
Marbling	2.5
Price	1.8
Grade	1.1
Other	3.3

Source: Anon. (97), Table 40.

A very recent report by Wilson *et al* (109) asked customers in North East of England supermarkets to select lamb custs of varying fatness, size and shape with price and colour held constant. The joints were cut from sides varying from 17 to 38% fat and weighing from 26-66 lbs. For all joints the leanest were preferred except for fillet of leg when size appeared most important. Shape had no effect. Their conclusions concerning most preferred joints can be tabulated.

Joint	Weight	Fatness of Animal (%)
Leg	2.5 - 3.5 lb	17
Fillet of Leg	2 lb	28
Shoulder	1.7 - 2.0 lb	27
Best Neck and Loin Chops	0.25 lb	25-29 and 8-9 mm fat depth

Source: Wilson *et al* (109), p. 25

A study of the effect of carcase weight on consumer preferences has been carried out in the U.S. by Southern and Field (105). In a self service meat counter rib and loin chops of similar fatness from 66 lb carcases were selected in a ratio of 6 : 5 over cuts from 50 lb carcases. In the case of leg roasts those from 50 lb carcases were selected in a ratio of 3 : 1 over 66 lb carcases but there was no difference when leg joints were

cut to the same weight. Barton (100) has used this evidence to argue for a heavier New Zealand carcase in the U.S. market, provided it is not fatter. In contrast, however, Stelly (107) reports most retailers as preferring lamb carcases of 40 lbs and additionally that 55% of chain stores preferred 'Choice' grade while 60% of independent retailers preferred 'Good' grade. Prime grade was disliked because it contained too much fat and was too expensive.

It has been suggested that lamb chops are one of the characteristics on which butchers' image is based. Carpenter *et al* (18) found that leanness of lamb chops was the one attribute which correlated with consumers' quality and price perceptions of butchers. The report suggests this may arise because lamb chops are more easily identified than many other cuts.

When it comes to physical measures of consumer requirements on eating many studies carry out similar experiments to those for beef and mainly using laboratory panel tests. No consumer survey studies have been observed which can be used for evidence of relationship of acceptability to physical characteristics*. Given that most people consider lamb to be tender and that the only study offering comparison to other meats (7) scored it second only to chicken for tenderness such assumptions that the same characteristics are important in consumer requirements for lamb as for beef seem questionable. Marsh in his study asked housewives why they purchased different cuts of lamb and while this related basically to reasons for purchasing it is worth noting that tenderness was mentioned only infrequently (36). In contrast there is more controversy over flavour in the U.S.A. and over amount/type of fat in U.S. and U.K.

Weller *et al* (108) conscious of trade discrimination against older lambs in the U.S.A. have carried out laboratory panel tests and failed to find any relationship to tenderness, flavour, or cooking loss. In contrast, Prescott and Hinks ** in a UK study of U.K. lamb of different ages and of U.K. and New Zealand origin detected tenderness and flavour differences but considered it doubtful if this would materially affect consumer acceptance.

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* Tenderness differences may be detected by laboratory panels as, for example, in Prescott, J.H.D. & Hinks, C.B. (1967). An Investigation of the Carcass Quality of Lambs and Hoggets with particular reference to the Cold-Storage of Home-Bred Lamb. Dept.Agr.Mkt., Rep.No. 7, Univ. Newcastle upon Tyne.

** *op cit*

Again, because of its poor or declining demand lamb presents an almost unique example of promotion and new product development if one excepts processed meats. Hunter *et al* (102) report on a 2 month advertising campaign in Cleveland, Ohio, which produced a 14% increase in sales volume during the second month, although a 14% decline occurred in the following month when advertising ceased. It is also worth noting that this advertising failed to shift consumer attitudes.

An early new product study (103) in the U.S. carried out a shop test for netted lamb roasts. These roasts from de-boned leg and shoulder joints, aimed to overcome complaints about the limited number of types of retail cut usually available, difficulty of carving, and over-large joint size. A very favourable reaction resulted with total lamb sales tripling during the promotion period and sales remaining 62% higher even four weeks after the promotion.

In another approach Sporleder and Branson (106) report attempts at marketing a new line of "frozen, boneless, boxed lamb products" in a low lamb consumption area. A moderately successful result was obtained with some increase in sales and evidence of repurchase. The common complaints related to excessive fat, disliked taste, and expensiveness.

CHAPTER 4

PORK

A very similar number of reports to those on lamb have been observed. Although demand for pork in the U.S.A. is weakening (121) it still ranks second in importance to beef. In Britain there is evidence of increasing demand. Perhaps as a consequence there are few, if any, attitude studies relating specifically to pork and indeed fewer consumer tests than for lamb or beef.

Baron *et al* (7) concluded that "pork is considered an appetising and reasonably nourishing meat, although not in the same class as beef, and is both tasty and tender. It is thought well of as a cold meat. However, it is also believed to be rather greasy and overfat, indigestible, not particularly versatile, and finally, rather expensive". Weidenhamer *et al* (47) in the U.S.A. summarised pork's image as less favourable than ham. "Although respondents themselves tended to characterise fresh pork as tasty, many have been unsure that others like its taste, as indicated by their reaction to the idea of serving pork cuts to guests whose preferences are not known." In addition, pork was considered tiresome, unsuitable for weight watchers, and difficult to digest, not always safe to eat, and to have too much waste. "Many also claim that pork is not good to eat cold and does not keep well before cooking."

A small scale French survey (129) reported that housewives considered it not expensive, easy to prepare, to have a mediocre prestige and to be too fat. It is used because it is cheaper than beef or mutton. Prepared pork such as smoked ham has more prestige than the fresh product.

Hughes' (29) examination of meat joints considered leg of pork as a typical week-end joint and concluded that it was "a cut that is thought to have good eating qualities and is useful in that it has good re-use properties. It is thought relatively economical but surprisingly does not score well on wastefulness". In this comparison it appears remarkably similar to leg of lamb. His mid-weel pork cut, pork chops, were thought to have "... good eating qualities but wasteful and therefore not economical". On each of the three aspects it apparently had a very similar and slightly improved score to that of lamb chops.

When individual scales are considered, pork chops and leg of pork score well in comparison with other beef and lamb mid-week and week-end meats. Only belly pork compares unfavourably.

In-store selection of pork appears to have generated most interest among researchers. An early study by Birmingham *et al* (110) produced the following responses to open-ended questioning on their reasons for choosing among joints from choice and medium grade carcases.

Major Reasons for Preference of Pork Cuts before Cooking by 361 Respondents in Columbia, 1953

	Bacon	Ham	Chop
Leanness	51	24	37
Freshness	17	23	21
Fatness	5	6	3
Colour	3	18	14
Marbling	0	4	2
Other	1	1	1
No Answer	23	24	22
	100	100	100

Source: Birmingham *et al* (110), Table 5.

Leanness, freshness, and colour appear to be the dominant characteristics. Howard *et al* (117) similarly note leanness and colour as judgement characteristics in the U.K. The preference for leanness as a major characteristic has been widely recorded in the U.S. (112, 120, 126, 128) in the U.K. (114) and in the rest of Europe (24).

The study reported by Rhodes *et al* (126) is interesting because it considers the relationship of leanness and price. The following table indicates the selection characteristic. The 'lean' and 'regular' grades were shop tested in a number of supermarkets when a 4 cent/lb premium was included for leaner joints. They considered that "most of these results are consistent with a model in which a minority of buyers select without inspecting both displays, another small minority select carefully for lean, and a majority consider a number of factors including possibly size, colour, total price, shape and fatness. Sales ratios will not vary quickly nor widely away from 1 : 1 in such a situation when one or two variables like fatness and price are quietly varied by relatively small amounts". However when examining the effect of the price change, the ratio elasticity

$$= \frac{\% \text{ change in sales ratio of lean to regular}}{\% \text{ change in price ratio of lean to regular}}$$

appeared to be -5.0 for ham shanks, -1.8 for loin roasts, and -0.7 for ham slices. Apparently therefore the lean preference

was much stronger for ham slices and the dramatic rate of decline in purchases of ham shanks indicates a much weaker preference. Pork loin roasts, while exhibiting a stronger preference still indicate a more than proportionate fall in sales of the leaner cut as price rises.

Specifications used in Selecting Test Product and the Expected Retail Grade

Hot Carcass Weight	Chilled Carcass Average Backfat Measurement(a)	Test Grade	Retail Grade(b)
pounds	inches		
140-160	1.0 - 1.3	0	Lean
	1.3 - 1.6	1	
156-175	1.6 - 1.9	2(c)	
	1.9 - 2.2	3	Regular
	2.2 - 2.5		

(a) Average of measurements at first rib, last rib and last lumbar.

(b) Retail grades "lean" and "regular" were classified on the basis of the photographic standards from all the test grades.

(c) Grade 2 was used only when carcasses from 3 and 4 did not yield an adequate supply of retail grade regular.

Source: Rhodes *et al* (126), Table 2.

Another U.S.A. study of pork chops by Larzelere and Gibb (120) included price changes and varying fat cover. While chops with $\frac{1}{8}$" fat cover had a higher preference score to those with $\frac{3}{8}$" fat cover imposition of a 3 cent/lb price premium on the leaner chops reversed this score. It is worth noting that another U.S. study (127) suggests little effect of price changes on selection but there is doubt in this case whether consumers detected any real difference in characteristics of the joints. No similar studies have been reported so far in the U.K. although it is known that there are tests under way.

Kauffman *et al* (119) carried out a consumer test to relate marbling and price. Customers were offered pork chops with a high degree of marbling and with very little. A definite preference for the unmarbled chops was observed and a price reduction of 8c/lb required to equate numbers of purchases between types.

When it comes to the nature of pork lean a typically American claim is that "the most desirable quality has a firm, dry surface that is pinkish red in colour. The quality-indicating characteristics evident on the cut surface of a major muscle include marbling, firmness, colour and exudation (40). Deficiencies in the latter three characteristics are of course typified as pale, soft, exudative (PSE) pork and entensive research has been carried out into its causes by animal production experts.

Although colour has been shown to be important there are no assessments relating consumer choice to pork of measured colour characteristics, namely hue, saturation, and lightness (40). Thus Larzelere and Gibb (120) show customers to prefer chops with a better colour as judged by experts, but we are not given any definitions of the colours offered other than good colour was "greyish pink" and poor colour was "darker and showed less marbling". Similarly Luby (121) suggests that decline in demand for pork in the U.S.A. is among other factors influenced by the pale colouring of pork under artificial light inside modern retailing establishments.

One study (112) shows preference for heavier pigs because of size of cut and another (130) suggests that small size of joint may be a disadvantage in the U.S.A. Marsh's study (36) indicates very tentatively that small size and economy was a reason for selecting belly pork in Leeds. However no other or more detailed experiments have been observed in this area.

Harrington (114) comments that quality of lean varies less in pork than in beef in Great Britain since they are comparatively immature at slaughter. It is possibly for this reason that tenderness appears less important as an eating characteristic. Indeed like lamb it may well be that flavour is a more important characteristic and again odour has been a source of concern at least for boar meat.

Consumers consider pork to be in general tender (29) in the U.K. and when comparing pigs of 125 and 200 lb liveweight "lack of tenderness was not a problem with pork cuts from any of the weight groups" in the U.S.A. (130). A laboratory panel study by Ramsey *et al* (123) finds overall acceptability relates to flavour rather than tenderness, explaining 82% of variation in acceptability as opposed to 6%. Similarly in the study by Birmingham *et al* (110) flavour emerges as the most important reason for selection of joints after cooking.

Major Reasons for Preference of Pork Cuts After Cooking by 311 Respondents in Columbia, April 1953

	Bacon	Ham	Chop
Flavour	64	52	50
Tenderness	7	28	24
Leanness	13	4	9
Fatness	1	0	0
Juiciness	0	2	2
Other	0	1	1
No Answer	15	13	14
Total	100	100	100

Source: Birmingham *et al* (110) Table 6.

In the study by Kauffman *et al* (119) however reasons given for preferring particular pork chops did include tenderness as the most mentioned characteristic of eating quality followed by juiciness and flavour.

Boar taint has been considered as aparticular problem in pig meat. In the U.S. Pearson *et al* (122) carried out tests on 22 fresh and processed pig meat products and concluded that consumers could not detect boar meat. Panellists carried out the tests in an area removed from cooking odours and with lighting control. Further tests in the U.K. (124, 125) suggest that consumers are unable to detect any differences between boars and gilts as bacon or pork. Moreover cooks failed to detect any odour differences at the cooking stage.

Only one attempt at promotion is reported by Hughes *et al* (118). This involved a branded pork product sold through co-operating butchers. Although some slight increase in pork sales was detected and an opinion survey reflected strong support for the brand name and idea of branded meat, the authors suggest an extended experiment would be required to draw firm conclusions.

CONCLUSIONS

Before attempting to identify what might be useful lines of research to be undertaken in the future, it seems desirable to make some general observations about the foregoing review.

The number of references included in our bibliography show that a very considerable amount of research into consumer requirements for meat has been undertaken, mostly during the last 25 years. We cannot claim to have traced all the work which has been carried out in every country, but are satisfied that in quoting mainly from work done in the United States and to a lesser extent in the U.K. we have reflected all the important findings which exist. It is known that little of this type of research has been undertaken elsewhere.

By far the greater part of the research which we have been able to trace deals with beef, so that pork and lamb have by comparison at least been neglected. We have shown that beef is regarded by the majority of consumers as the most important meat. Nevertheless, neither this nor the general impression that lamb and pork are less likely than beef to evoke disapproval, because of lack of tenderness, prevent us from concluding that more research is needed with these two meats. We have, indeed, disputed the assumption, implicit in much of the work dealing with pork and lamb, that tenderness is necessarily an important criterion by which consumers judge the quality of one offering of either meat against another. The fact that there may be less consumer dissatisfaction with the tenderness of the pork and lamb which they eat than with that of beef might suggest the need for more refined assessments than have so far been attempted for beef. These should emphasise characteristics which have first been identified as specifically applying to these two meats. For example, we have included evidence that, for pork, flavour may be more important than tenderness, and though we have shown that a strong beef flavour is generally desired, it is easy to imagine that the reverse might be true for lamb. There may also be other so far unrecognised characteristics of lamb and pork which could be quite relevant to consumer acceptability.

While we must declare some itnerest, with which the Commission has been notably associated, we would claim that what is now known about consumer requirements for carcase meat in general and for beef in particular represents some advance on the state of such knowledge as recently as 15 years ago. Then the argument ran high as to whether tenderness, leanness, flavour, or some other less obvious characteristic was most considered by consumers when defining their requirements. Now one can be reasonably certain that, for beef, tenderness, leanness, appearance and flavour, in that order, are the principal determinants of acceptability, and

that, for lamb and pork, leanness is of overriding importance. Moreover, for some characteristics, and for some cuts, it is possible to make reasonable assessment of the different levels of acceptability.

Nevertheless the reader is perhaps entitled to feel some disappointment that no more precise assessments of consumer preferences than those included in this review, particularly as far as levels of acceptance are concerned, can be derived from so much published work. The reasons for this are quite relevant to any planning of future research.

First, little of the early research and by no means all of the later work can be described as fully market orientated. Among the pioneer workers there were in addition to some marketing specialists, many others in animal production and several economists whose first concern had been production. It is not uncommon therefore to find U.S. research in particular which attempts to relate consumer acceptance to specific types of production, leading to breed comparisons, examination of the effects of tenderizing or contrasts between meat from animals of different sexes. Fully market orientated research would rather attempt first to identify characteristics of the meat important to consumer acceptance, then to establish desirable levels of these criteria, such as tenderness or leanness and finally to seek ways in which such meat could be provided.

A similar dilution of the applicability of results to practical problems arises because a considerable amount of U.S. research examines relative acceptability of different U.S. grades. The characteristics of these grades, important to consumers, are not widely known and may not always be clearly defined. Even if they were, they would not be relevant to conditions in all or perhaps many other countries. For example, there is very little beef on sale in the U.K. which would grade U.S. Prime or U.S. Choice and what there is does not find favour. We know, however, that Rhodes, one of the most prolific writers, was aware of the problem arising from more production than market orientated grading. Indeed the results of research often highlight this situation.

A second reason for the limited amount of really precise information on acceptable levels of different physical characteristics which we have been able to find is that meat is virtually the first commodity as opposed to a branded product to which the techniques of market research have been applied. While the problem was therefore a new one, it also had to be tackled with enormously less powerful techniques than have since become available in the whole field of market research. The Newcastle work exemplifies this well. Full scale attitude research, using modern techniques, which should ideally have preceded testing of physical preferences

could not be undertaken until most of the latter work, regarding beef at least, had been discontinued. Instead, the first step had to be much less rigorous and therefore necessarily less conclusive examination of consumer attitudes. It may be that many of our published sources would have provided more precisely measured levels of acceptability had workers not often felt obliged to re-establish what the important criteria of acceptability might be.

Finally there is the problem of cost which needs to be clearly recognised. Not only are the costs of meat research likely to be higher than those of similar investigations for most branded goods, but the value of results is harder to forecast beforehand, or even to assess when they become available. A company, concerned with a brand, can at least estimate the value of research in terms of either possible loss avoided or potential, even actual, profit. It is far harder to evaluate the return on meat research as this accrues to various sections of the trade, the farmer and the consumer, even supposing its findings are put into practise. As a result workers, conscious that costs are high and knowledge very limited, have often aimed at results which would be of interest to several section of the trade as well as to consumers, thus tending to pursue the general rather than the particular. Besides samples have often had to be too small and too localised to allow disaggregation, and sometimes fields of investigation relevant to the main subject of the research have had to be neglected.

There are therefore three main general conclusions to be drawn.

1. Though the assistance of animal production and other specialists will often be necessary, no consumer research into requirements for meat should be initiated except under the direction of someone with full training or experience in market research. This may now be generally recognised but the issue is so important that it seems necessary to make the point.

2. It is now possible to undertake more meaningful research than during most of the time covered by this review. New techniques hold out the possibility and will do so increasingly, of not only examining acceptability more precisely than has been so far the case, but also of researching aspects of preference which seemed more intractable even five years ago. For example, one might now envisage the use of trade off models to find with some accuracy how much consumers might be prepared to pay for their preferences.

3. Since costs will not diminish and resources are unlikely to expand, we would strongly recommend that most future research should be highly specific. Not only will this make for economy but it should place the main research effort where it is most needed, and where it can now be more sensibly directed than was perhaps the case before the general problem of consumer requirements had been explored to the extent that it now has.

We have not felt that we should attempt to set priorities among the different types of research which are discussed below, since this is taken to be the field of the policy maker. Instead we enumerate some of the more notable gaps in knowledge which we have found to exist at this moment, and which we consider could be profitably researched at some time in the future.

(a) Most consumer tests, using actual meat, have been undertaken with beef steaks, either from the sirloin or the round and with lamb or pork chops. Only the most tentative conclusions can be drawn from those to be applied to beef, lamb, and pork in general much less to other cuts in particular. Yet roasts, stews and mince constitute the greater part of meat consumption. Physical criteria of preference need to be established at least for each of the major roasts, for beef mince and for beef and lamb stewing meat. Some of this work could be attitude research such as would extend the range of cuts which have been studied and improve on attempts to relate attitudes to consumption.

(b) Not only for the so far neglected cuts but also for those which have already received some attention there is an obvious need to establish with a reasonable degree of precision the levels at which the different criteria are acceptable.

In making these two suggestions we do not expect that it will necessarily be possible to define ideal carcases for beef or perhaps even pork or lamb from which high proportions of all cuts with the desired characteristics will be obtained. Requirements for different cuts could even conflict. The object would be to define what is desirable leaving the problem of its attainment to the operation of specialists in animal production, slaughtering, conditioning and retail processing. Nor do we know whether or not the results would suggest the need for more processing than is traditional with fresh meat.

(c) Only for pork and lamb would we recommend a more general approach because of the lack of published work dealing with these two meats. In each case a large scale project might be mounted *de novo*, beginning with attitudes to all important cuts and working through to establishment in each case of levels of acceptability for those characteristics which had been identified as important.

(d) It has been shown from almost all the work dealing with physical requirements that there is usually some segment of the market in any country with ideas of acceptability differing from what appears to be the majority view. Thus while most people are satisfied with reasonably tender beef, 24% are only moderately satisfied unless it is extremely tender. Similarly 15% of the population would enjoy fattier beef than would the majority and perhaps 25% are capable of distinguishing flavour differences which the rest cannot. In short, there is evidence that the common contention that there are several consumer beef markets with varying requirements may be perfectly correct. Virtually nothing however is known about these market segments apart from the fact that their size appears to warrant consideration, and that they are probably not associated with standard socio-economic classification. We need to know more about how they are composed whether by age, sex, education, location or some other segmentational variables, and more about the intensity of the preferences they display. As a start the possibilities of segmenting the market according to fattiness might most usefully be researched.

(e) The most unsatisfactory results of existing research are those dealing with flavour. Various devices have been used to offer meat with different types or intensities of flavour but no more objective method than the use of tasting panels has been devised. Really rigorous work aimed both at defining flavours and testing for their acceptance might yield spectacular results. We recognise, however, that any such work may have to wait upon the efforts of meat scientists.

(f) Though there have been a number of shop tests designed to compare the acceptability of meat with different characteristics, there has been little work to throw light on the effect of the shopping environment on meat purchase. As self service continues to grow there will be a need to examine the effect of different merchandising practices, such as display, presentation, point of sale promotion and the location of the counter on the sales of meat.

(g) We have noted that there has been only limited advertising

research with regard to meat in the U.K. and only slightly more in the U.S.A. We hesitate to recommend that more should be undertaken *per se*. Instead we would like to see some examination of the possibilities of full brand marketing of fresh meat. There is already some evidence that this would be approved by the consumer but the trade is notably cautious. While a full scale test of a branding operation would be very expensive, it would appear that the trade would welcome information on potential costs and consumer acceptability. Given this, wholesalers might be more inclined to test the market themselves. Acceptability in this instance would require to be studied among retailers as well as consumers.

(h) A few of the consumer tests which we have examined took some account of cooking techniques but there emerges no clear evidence on what if any are the effects of different cooking methods on acceptability. This might offer another useful line of enquiry.

(i) It is almost an article of faith that market research is more concerned with discovering what attitudes and preferences exist than with finding out how these can be influenced or modified. This review bears witness to how strongly this view is held since we can find no research into educating the consumer about uses of different cuts, cooking methods and so on. Yet, we have shown that some research indicates that consumers are badly informed about different cuts, and have suggested that it may prove impossible to tailor all fresh meat to consumer requirements. The Commission itself has a continuing commitment in education of the consumer. It appears, therefore, that some research would be worthwhile aimed at evaluating existing programmes of consumer education and at developing subject matter as well as methods of dissemination.

(j) We have confined our attention to beef, lamb and pork. Nevertheless, it appears to us that the enormous increase in poultry consumption and the possibilities of higher consumption of other protein foods, including synthetics, calls for research to establish the competitive position of the traditional carcase meats with these foods.

By way of conclusion two general observations are called for. The meat trade is not notably interested in the possible benefits which it might derive from market research. Indeed it could be some time before many firms adopted practices suggested by the results of published work. If therefore requires considerable faith on the part of any organisation which sponsors such research,

though it can be sure that none other than public bodies will readily do so. Finally, though we have confined our attention in these conclusions to gaps in existing knowledge, fashions in taste will change, the more so with meat since the product itself is changing. Thus when, for example, we record that beef steaks should be above all tender, comparatively lean and that flavour is not very important, we quote what was shown to be true, ten years ago. It is perfectly possible, indeed quite likely, that the relative importance of these criteria has already changed if not ordinally at least cardinally. We have the impression, in any case, that the consumer is less likely now than then to obtain tough beef. Therefore much of the research already undertaken will continue to require repetition from time to time.

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Steak	9	43

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Meat Production and Distribution in France. 1. Beef, Veal and Mutton. S.E.D.E.S. Pt. 3, Chap. 2, Section 2, pp.334-36.

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47. cont'd

Complaints centered on packaging. Little interest in buying frozen meat mostly because could not judge its freshness though most sometimes freeze meat when taken home.
Respondents images:
Beef: (most frequently eaten) tasty, easily digested, versatile, healthful, little waste, not tiresome. Okay for eating cold, but steak expensive.
Chicken: beef's advantages with few disadvantages but concern over keeping qualities and tiresome.
Fresh Pork: tasty "but others may not think so", tiresome, unsuitable for weight watchers, difficult to digest, not always safe to eat, too much waste, not good to eat cold and doesn't keep well before cooking.
Lamb: considered in less detail. General lack of flavour. Some disliked flavour or odour. Lack of exposure in parental home a reason for not using.
General: Older more interested in nutrition. Considerable confusion of fact: e.g. thought pork graded at retail level, which it is not.

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Beef

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A report on the Market for Cattle and Beef in France.
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Section on consumption with general comments on preferences.
"Because of high price sheep meat has a luxury image in France and demand confined mainly to upper income groups."
"Prime beef consumption not greatly affected by price, great emphasis placed on eating "quality foods" in general."
Hindquarter cuts preferred, lean and with longer hanging period than is customary in U.K. to promote tenderness.
Variability within country exists e.g. Marseilles prefer fatter carcases.
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60. BRANSON, R.E. and KING, G.T. (1960)
A Consumer and Retail Market Test of Prepackaged De-boned Frozen Beef. Texas Ag. Exp. Stn. Bull. 958.

Retail shop test for 4 weeks in Waco, Texas in 1956 and 1959 plus a 1800 family probability cluster sample on attitudes. Preference for fresh red meats revealed.

61. BRADY, D.E. (1957)
Results of Consumer Preference Studies. J.An.Sci. 16 : 233.

Reviews literature and relates preferences to U.S.A.grades for beef.

62. CAMPBELL, G.W. (1956)
Consumer Acceptance of Beef: A Controlled Retail Store Experiment. Ariz. Ag. Exp. Stn. Rep. 145.

Shop test. 1104 consumers bought different grades at identical price. Leanness preferred as reflected in commercial and good grade. Give tenderness, tastiness and juiciness for eating satisfaction.

63. BRAYSHAW, G.H., CARPENTER, E.M. and PERKINS, R.J. (1967)
Consumer Preferences for Beef Steaks. Dept. Agr. Mkt.Rep. No. 2, Univ. Newcastle upon Tyne.

Product test of beef steaks varying in tenderness, leanness and flavour by 1000 households in five towns in 1964/5. Panellists failed to detect flavour differences of barley and mature beef. Seventy-five per cent of panellists wanted 20-30% visible fat. Overall acceptability correlated with tenderness and 50% considered steaks very tender with Warner Bratzler shear of 22 lbs. or less.

64. CARPENTER, E.M., HINKS, C.E. and PERKINS, R.J. (1968)
Price Premiums for Quality Beef Steaks: A Supermarket Experiment. Dept. Agr. Mkt. Rep. No. 11, Univ. Newcastle upon Tyne.

Steaks of varying leanness and tenderness offered in shop test in London supermarket. Shows customers prepared to pay considerable premium for steaks with 13% as opposed to 30% visible fat.

65. COLE, J.W. and BADENHOP, M.B. (1958)
What do Consumers Prefer in Steaks. Tenn. Farm & Home Sci. Prog. Rep. No. 25.
(cited in Blumer, 1963)

"Found flavour to be more important than juiciness in overall preference ratings."

66. DUNSING, M. (1959)
Visual and Eating Preferences of Consumer Household Panel for Beef from Animals of Different Age. Food Tech. 13 : 332.

Steers of ages 18 months and 30 months compared. 335 households in April 1958. Younger carcases preferred for eating, for steak off sirloin or short loin. Visually differed by by age: older short loin, younger sirloin steaks preferred. Younger preferences appear to emphasise tenderness; taste and juiciness preferred with older steak preference.

67. DUNSING, M. (1959)
Consumer Preferences for Beef of Different Breeds Related to Carcase and to Quality Grades. Food Tech. 13 : 516.

Consumer panel. 494 households Sept-Oct 1958. U.C. Davis. Eating preferences related to breed and grade significantly. Preferred darker colour of Holstein to Hereford. Preference varied for steaks of different wholesale cuts. Herefords preferred for tenderness, Holsteins for taste.

68. EPLEY, R.J., STRINGER, W.C., HEDRICK, H.B., SCHUPP, A.R., CRAMER, C.L. and WHITE, R.H. (1968)
Influence of Sire and Length of Feeding on Palatability of Beef Steaks. J.An.Sci. 27 : 1277.

Interesting in that shows flavour differences between sire detected by laboratory panel but not by consumer panel of 200 households: similarly for tenderness. Notes cooking may have affected this.

69. FIELD, R.A., SCHOONOVER, C.O. and NELMS, G.E. (1964)
Performance Data, Carcase Yield, and Consumer Acceptance of Retail Cuts from Steers and Bulls. Wyo. Ag. Exp. Stn. Bull. No. 417. (cited in Woodhams, P.R. and Trower, S.J. (1965) Palatability Characteristics of Rib Steaks from Aberdeen Angus Steers and Bulls. N.Z. J. Ag. Res. 8 : 921)

Reports that consumers rated taste and tenderness characteristics of bull steak significantly lower than those of steer. Unidentified cuts in self service counter showed customers to select bull chuck roasts in approx. ratio 3 : 2 over similar steer roasts because of less intermuscular fat. Maintain bull beef is acceptable as over 85% of consumers scored bull beef 'good' or very good. Ninety-one per cent of consumers would buy again and 88% and 92% of consumers satisfied with bull and steer chuck roasts; i.e. rejects idea that cooked bull beef has too strong an aroma and flavour.

70. HALL, L.D. and EMMETT, A.D. (1912)
Relative Economy Composition and Nutritive Value of the Various Cuts of Beef. Ill. Bull. 158.

Attributes most of the variation in prices of various cuts of beef to "considerations other than their food value, such as tenderness, grain, colour, general appearance, and convenience of cooking".

71. HOOD, D.E. and RIORDAN, E.B. (1973)
Discolouration in pre-packaged beef: Measurement by Reflectance Spectrometry and Shopper Discrimination. J. Food Tech. 8 : 333.

Shows shoppers discriminate in favour of bright red beef.

72. KIEHL, E.R., RHODES, V.J., BRADY, D.H. and NAUMANN, H.D. (1958) St. Louis Consumers' Eating Preferences for Beef Loin Steaks. Mo. Res. Bull. No. 652.

Consumer panel of 266 St. Louis households.

73. LASLEY, F.G., KIEHL, E.R. and BRADY, D.E. (1955) Consumer Preferences for Beef in Relation to Finish. Mo. Agr. Exp. Stn. Res. Bull. 580. (cited in Williams, E.F. *et al* (1959) Economic Effects of U.S. Grades for Beef).

74. MEANS, R.H. and KING, G.T. (1959) The Effect of Sire on Tenderness of Beef Loin Steaks as Measured by a Panel of Families and the Warner-Bratzler Shear Machine. J. An. Sci. 18 : 1476, Abstract 40.

40 families from 4 income groups. Overall satisfaction rating correlates with tenderness (0.904) and with Warner-Bratzler measure of tenderness ($P < .01$)

75. MEYER, T.O. and ENSMINGER, M.E. (1952) Consumer Preference and Knowledge of Quality in Retail Beef Cuts. Wash.State Ag. Exp. Stn. Circ. 168 (revised). (cited in Brady (1957))

Shop test of identically priced chuck pot roasts and short loin steaks from different grades of carcase. High preferences shown for low grades.

76. McCOMISH, J.R. (1971) A pilot Study of Consumer Selection and Usage of Beef Cuts in Palmerston North. Consumer Res. Rep. 2, Massey Univ., N.Z.

Cluster sample of 38 housewives interviewed. Housewives generally appear bewildered by range of cuts available. Lacking ability or confidence to make visual assessment of quality , they limit purchases to small range of cuts with which familiar from experience or tradition.

77. McHUGH, H., NAUMANN, H.D. and RHODES, V.J. (1959) Consumer acceptance of Round Steaks Tenderised by Cubing and Papain. Mo. Ag. Exp. Stn. Bull. No. 713.

Consumer Panel of 30 households near University. In case of some steaks excessive tenderness achieved at expense of flavour.

78. MIZE, J.J. and STRINGER, W.C. (1959) Choosing Beef for Household Use. Georgia Ag. Exp. Stn. Bull. No. 64. (cited in Barton, R.A. (1972))

79. NAUMANN, H.D., BRASCHLER, C., MANGEL, M. and RHODES, V.J. (1961) Consumer and Laboratory Panel Evaluation of Good and Choice Beef Loins. Mo. Res. Bull. No. 777. (cited in Price and Schweigert (1971))

400 member consumer panel in St. Louis County Missouri. Weak relationship of marbling to acceptance.

80. OORD, A.H.A. and WESDORP, J.J. (1971) Color Rating and Pigment Composition of Beef. J. Food Tech. 6 : 15.

Suggests acceptability stops when pigment in meat surface comprises approx. 50% oxy Mb.

81. PRESCOTT, J.H.D. and HINKS, C.E. (1968) Systems of Management and Carcase Quality of Steers. Dept. Agr. Mkt. Rep. No. 8, Univ. Newcastle upon Tyne.

Includes a shop test of Friesian beef of varying age at slaughter. Subsequent interviews with approx. 100 housewives showed leanness and colour of lean to be most important at point of purchase, tenderness and flavour on eating. Little difference in ratings between ages but varying importance between joints.

82. PUIG, J.P., FIELDS, P.A., CARPENTER, Z.L. and SMITH, G.C. (1972) Measurement of Beef Colour Acceptance. J. An. Sci. 31 : 187. Abstract.

83. RHODES, V.J., KIEHL, E.R. and BRADY, D.E. (1955) Visual Preferences for Grades of Retail Beef Cuts. Mo. Res. Bull. 583.

Two-stage probability sample of 1469 customers interviewed in St. Louis stores. Questioned about sample beef cuts and indicated visual preferences.

84. RHODES, V.J., KIEHL, E.R., WILSON, N.B. and others (1956) Consumer Preferences and Beef Grades. Mo. Agr. Exp. Stn. Bull. 612. (cited in Williams, *et al* (1959))

85. RHODES, V.J. and KIEHL, E.R. (1959) Predicting Consumer Acceptance of Beef Loin Steaks. Mo. Ag. Exp. Stn. Bull. 651.

Two-stage cluster sample of 266 St. Louis white households in Oct. 1955.
Positive but weak correlation between consumer and laboratory panel. Panel comparisons of U.S.D.A. grades made using 9-point scale. Overall acceptability related to grade but prime and choice so overlapped that could be combined. Other grades lacked homogeneity.

86. RHODES, V.J., JORDAN, M.F., NAUMANN, H.D., KIEHL, E.R. and MANGEL, M. (1958)
The Effect of Continued Testing upon Consumer Evaluation of Beef Loin Steaks. No. Ag. Exp. Stn. Bull. 676.

60 Columbia families evaluated U.S.D.A. graded beef over 12 week period. Acceptability ratings of husbands and wives were much alike and correlations between mean ratings by a laboratory panel and consumers were tenderness, 0.69; flavour, 0.56; and juiciness 0.13. Consumer panel acceptability correlated 0.68 with mean shear values. Seventy-nine per cent of loins rated as 'like' had a Warner Bratzler shear of 18 lbs or below. Incorporates additional data to show that "loins with shear weights below 20 lbs are much more likely to be acceptable ...".

87. RHODES, V.J., NAUMANN, H.D., KIEHL, E.R., BRADY, D.E. and COOK, R.H. (1958)
A New Approach to Measuring Consumer Acceptability of Beef. Mo. Ag. Exp. Stn. Bull. 677.

Includes evidence that household and laboratory panels were similar for only one (top round) of three steaks evaluated.

88. RHODES, V.J. (1961)
Acceptance and Yield of Choice and Good Beef: Research Results and Implications. J. Farm. Econ. 43 : 187.

89. SCHUPP, A.R. (1970)
An Economic Evaluation of Sire and Length of Feeding on Acceptance of Beef Loin Steaks and on Pricing Accuracy in the Beef Marketing. Diss. Abstr. Int. A. Ann. Arbour. Mich. 30, 8, 3166.
(from World Agr. Econ. & Rural Sociology Abs. 13 : 3461)

400 member consumer panel fails to detect difference in tenderness, flavour, and overall desirability whereas six member taste panel did detect differences.

90. SELTZER, R.E. (1955)
Consumer Preference for Beef. Ariz. Agr. Exp. Stn. Bull. 267. (cited in Hudson and Danner (1961))

91. STEVENS, I.M. *et al* (1956)
Beef - Consumer Use and Preferences. Colo. Agr. Exp. Stn. Bull. 495S.
(cited in Hudson and Danner (1961))

92. Van SYCLE, C. and BROUGH, O.L. (1958)
Consumer Acceptance of Fat Characteristics of Beef. Wash. Ag. Exp. Stn. Tech. Bull. No. 27.
(cited in Williams and Stout (1964))

93. WILLIAMS, W.F., BOWEN, E.K. and GENOVESE, F.C. (1959)
Economic Effects of U.S. Grades for Beef. U.S.D.A. Mkt. Res. Rep. No. 298.

Contains useful summary of work on consumer preferences studies during the 1950's.

94. WOODHAMS, P.R. and TROWER, S.J. (1965)
Palatability Characteristics of Rib-steaks from Aberdeen Angus Steers and Bulls. N.Z. Journal of Ag. Research 8 : 921.

Laboratory panel evaluation of meat from 11 bulls and 11 steers of Aberdeen Angus breed. No major differences in aroma, flavour, tenderness and juiciness detected.

95. WOODS, B.L. and JENKINS, M.C. (1963)
Motivation in Consumer Purchases of Beef. Louisiana Ag. Exp. Stn. Bull. No. 565.

96. ANON. (1963)
Survey on Lamb Consumption and Opinion about Lamb in 14 U.S. Cities. Young & Rubican Research for American Sheep Producters Council, RPO-SF 244.

Systematic telephone questionnaire of approx. 100 housewives. Housewives consider little lamb is consumed in U.S. because of unliked taste, ignorance of use and availability, unliked odour, expensive, too much fat or waste.

97. ANON. (1964)
Lamb and the Consumer: Preferences, Attitudes and the Image of Lamb in the U.S. American Sheep Producers Council in cooperation with U.S.D.A.

Multi-stage stratified random sample using area probability sampling in U.S. yielding 3117 questionnaires.
Lamb seen as tender but less so than beef, veal, pork or chicken, easy to digest, a meat which one tires of, expensive, and not versatile.
Used at Easter and for special guests.
Leanness a major component of choice criteria.

98. AVERY, F.B. (1965)
A Sure Route - the Youth Route to Increased Lamb Consumption Today and Tomorrow. Ingenue Magazine for Am. Lamb Council. Chicago, Ill.

Includes results of Ingenue panel survey made in Feb. 1963 of 754 teenage girls and indicates an open mind regarding lamb.

99. BARTON, R.A. (1967)
A Review of Meat Research at Massey University. Sheep Farming Annual 1967 : pp. 127-39.

Notes that consumers often think lamb to be greasy, resulting from lower melting point of its fat. This is referred to as "hardness of fat" and refers to work on melting point, e.g. Shorland *et al* (1967) J. Agric. Sci. 68 : 221.

100. BARTON, R.A. (1972)
Does New Zealand Lamb Meat Consumer Requirements? Sheep Farming Annual, 1972, pp. 14-37.

General review of consumer requirements particularly in U.S. and U.K. but also other markets for N.Z. lamb.

101. CARMEN, H.F. (1973)
The Demand for Lamb in the U.S. Sheep Farming Annual, N.Z. 1973.

Include a review of consumer and preference and attitude work in U.S.

102. HUNTER, J.S., CLEMENT, W.E. and HAVAS, N. (1958)
Promotion of Lamb - Results of a Campaign in Cleveland, Ohio. U.S.D.A. Agr. Mkt. Serv. Mkt. Res. Rep. 292.

Includes data for survey updating Levine and Hunter (1956) and shows advertising has little effect on homemakers' attitudes. Flavour and odour main reasons for not using lamb. Based on area probability sample of 631 respondents (usually housewife) in Oct. 1956.

103. LESTER, W.B. and BRANSON, R.E. (1966)
Netted Lamb Roasts: Texas Consumer Market Test. Texas A & M with E.R.S. of U.S.D.A. Rep. MP 821.

A new product designed to overcome problem of limited type of retail cuts available. Eleven week retail store test in Bryan College Station plus a consumer panel test of 300 families in Waco, Texas.
Very favourable response.

104. LEVINE, D.B. and HUNTER, J.S. (1956)
Homemakers' Preferences for Selected Cuts of Lamb in Cleveland, Ohio. U.S.A.A. Ag. Mktg. Serv. Mkt. Res. Rep.113.

105. SOUTHERN, E.R. and FIELD, R.A. (1969)
Influence of Carcase Weight upon Carcase Composition and Consumer Preference for Lamb. J. An. Sci. 28 : 584.

In a self-service meat counter rib and loin chops from 66 lb. carcases selected in ratio of 6 : 5 over 50 lb. carcases. In case of leg roasts those of 50 lb. carcases selected in ratio of 3 : 1 over 66 lb. carcases, but no difference when leg joints cut to same weight.

106. SPORLEDER, T.L. and BRANSON, R.E. (1971)
Retail Test Marketing and Consumer Evaluation of Frozen Lamb. Texas Ag. Mkt. Res & Dev. Center Res. Rep. 71-4.

Shop test and consumer telephone survey of 587 households of new line of frozen, boneless, boxed lamb products. Taste and expense main reasons for non re-purchase.

107. STELLY, R. (1959)
Consumer Attitudes and Handling Practices of Retailers of Lamb, Mutton and Goat. Texas Ag. Exp. Stn. Bull. 925.

Personal interview survey of 2687 householders in Waco and San Antonio, Texas in 1956. Persons served lamb as children twice as likely to use lamb as those not served lamb. Users mention flavour as most appealing characteristic, odour cited by non-users as reason for not liking.

108. WELLER, M., GALGAN, M.W. and JACOBSON? M. (1962)
Flavour and Tenderness of Lamb as Influenced by Age.
J. An. Sci. 21 : 927.

Heavy lambs have been discriminated against on the market because of the belief that consumer prefers young lamb. Experiment shows tenderness and cooking losses appear unrelated to age and no significant difference in flavour preference. Laboratory panel study.

109. WILSON, A., LESSER, D. and PRESCOTT, J.H.D. (1974)
Lamb Consumers Prefer. Dept. Agr. Mkt. Rep. No. 19, Univ. Newcastle upon Tyne.

Five cuts of lamb (leg, fillet of leg, shoulder, best neck chops and loin chops) displayed in North-Eastern supermarkets with prices stated and customers asked to state preferences for fatness, weight of joint and shape of joint. Approx. 200 customers questioned for each joint. Leanness most important except for fillet of leg when size more important. Shape differences rarely noticed.

Pork

110. BIRMINGHAM, E., BRADY, D.E., HUNTER, S.M., GRADY, J.C. & KIEHL, E.R. (1954)
Fatness of Pork in Relation to Consumer Preference. Mo. Ag. Exp. Stn. Res. Bull. 549.

Area probability survey of 600 households in Columbia in April 1953. Leaner pork preferred. Freshness and colour next most important.

111. CARPENTER, Z.L., KAUFFMAN, R.G., BRAY, R.W. and WECKEL, K.G. (1965)
Interrelationships of Muscle Color and Other Pork Quality Traits. Food Tech. 19 : 1421.

Shows colour not related to tenderness. Juiciness was improved in darker muscles and implied flavour may be more acceptable in darker, lightweight loins. Laboratory panel and physical measures employed.

112. EMERSON, J.A., PEARSON, A.M., HOEFER, J.A., MAGEE, W.T. and BRATZLER, L.J. (1964)
Effect of Slaughter Weight upon the Processing Characeristics, Quality and Consumer Acceptability of Pork Carcases and Cuts. J. An. Sci. 23 : 436.

Experimental shop test on University campus included. Preference shown for heavier pigs because of size of cut but rejected excess fat.

113. GAARDER, R.O. and STRAND, N.V. (1957)
Use of Photography in Consumer Preference Studies of Pork. J. Farm. Econ. 39 : 59.

Concludes photos can be used for preference studies related to surface characteristics.

114. HARRINGTON, G. (1958)
Pig Carcase Evaluation. Tech. Communication No. 12, Commonwealth Ag. Bureaux.

Mainly a description of techniques used for assessing pig quality. Emphasises leanness as the principal consumer requirement. Considers quality of lean varies less in pork than in beef in G.B., since they are comparatively immature at slaughter.

115. HARRINGTON, G. and PICKARD, D. (1966)
A Report on Some Investigations with Bacon. Produce Studies, Rep. No. 524.

Pseudo-random consumer panel of 1050 families made paired comparison of Danish and Wiltshire, green and smoked bacon in vacuum prepacks. Thirty-seven per cent thought Wiltshire too fat but no differences in eating quality. Wiltshire slightly preferred to bacon from heavy pigs, suggesting variation in preferences and slight ability to distinguish between bacons.

116. HENDRIX, J. *et al* (1963)
Consumer Acceptance of Pork Chops. Mo. Ag. Exp. Stn.Res. Bull. 834.
(from World Agr. Econ. and Rural Sociology Abs. 6 : 2691)

Consumer and laboratory panel for appraisal.

117. HOWARD, A.N., SMITH, W.C., LESSER, D. and WEEKS, W.G.R. (1972)
Butchers' and Consumers' Reactions to Meat from Pietrain-Cross Pigs. Proc. Br. Soc. An. Prod. p.136, No. 23.

Shop, laboratory panel and consumer tests show preference for Pietrain because of higher lean/fat ratio and better colour of lean. Little differences on eating assessment.

118. HUGHES, D.R., LESSER, D. and RENARD, D. (1974)
Cracklean: an Experiment in Branding POrk. Dept. Agr. Mkt. Rep. No. 18, Univ. Newcastle upon Tyne.

Involves a 4-week shop test of branded pork supported by advertising campaign and interviews with 1182 housewives in Leeds and Sunderland. Measures shop sales and housewives' opinions.

119. KAUFFMAN, R.G., BRAY, R.W. and SCHAARS, M.A. (1961)
Price vs. Marbling in the Purchase of Pork Chops. Food Tech. 15 : 22.

Shop test with marbled and lean chops. Five difference margins. Marbled chops had to be reduced in price considerably to induce purchase although a taste preference indicated for marbled chops in take-home test. (62% preferred marbled chops). Meat Plant employees shop. 1800 persons saw counter, 213 purchased pork chops.

120. LARZELERE, H.E. and GIBB, R.D. (1956)
Consumers' Opinions from Detroit telephone directory. Paid to visit laboratory and rate sample pork chops. Approx. 125 consumers each month Jan-May 1956. Chops marked with symbols (#, %, &, *, (),) and wrapped in cellophane. Selected to indicate various deficiencies. Sample "without defect" not most populat.
Kind of chop: amount of fat cover and colour were major factors used by panel in selecting chops. Application of price differentials changed choice.

121. LUBY, P.J. (1958)
Declining Demand for Pork. J.Farm Econ. 40 : 1832.

Suggests that three factors retard consumption of pork. The greater shrinkage of pork at retail level; the pale colour of pork in artificial light; the expansion of catering at the expense of cold packed meals for which pork was extensively used.

122. PEARSON, A.M., CODDY, S., PRICE, J.F. and LARZELERE, H.E. (1971) Panel Acceptability of Products Containing Boar Meat. J. An. Sci. 33 : 26.

Consumer panels of 60 and 109 in M.S.U. and Detroit respectively. Large consumer panels cannot detect boar taint when preparation and eating areas separated.

123. RAMSEY, C.B., LIND, K.D., TRIBBLE, L.F. and GASKINS, C.T. (1973)
Diet, Sex, and Vacuum Packaging Effects on Pork Ageing. J. An. Sci. 37 : 40.

Important in that from laboratory panel relates overall acceptability to flavour as opposed to tenderness.

124. RHODES, D.N. (1971)
Consumer Testing of Bacon from Boar and Gilt Pigs. J. Sci. Fd. Agric. 22 : 485.

125 household consumer panel, in Bridgewater, assessed at cooking and eating to show negligible differences in acceptability for Large Whites and smaller differences in flavour of Landrace pigs.

125. RHODES, D.N. (1972)
Consumer Testing of Pork from Boar and Gilt Pigs. J. Sci.Fd. Agric. 23 : 1483.

Pork joints from 24 week-old boar and gilt carcases assessed by 419 households in Bristol. Judgement for odour by the cook during roasting and by family members at table showed no significant differences in acceptability.

126. RHODES, V.J., NAUMANN, H.D., KIEHL, E.R. and JAENKE, E.A. (1960)
Consumer Acceptance of Lean POrk. J. Farm Econ. 42 : 18.

Reports on sample of 300 shoppers in Columbia who judged photographs of ham and pork chops. Preference shown for photo with smaller amount of internal fat. In addition a shop test in representative sample of 14 Kansas City supermarkets of rib-end loin roast, shank end smoked hams, and centre cut ham slices of differing fatness. Lean joints outsold regular joints even when price differential supplied.

127. TROTTER, C. and ENGELMAN, G. (1959)
Consumer Responses to Graded Pork. Penn.Stn.Exp.Bull. 650.

Shop test in 10 self-service stores in Pittsburgh area from Feb. to May 1955. Three grades established on basis of back-fat thickness and 8 price differences formulated. No significant change in sales or recognition of grade differences by consumers.

128. VROOMAN, C.W. (1952)
Consumer Report on Pork Products. Ore.Ag.Exp.Stn.Bull. 521. (cited in Williams and Stout (1964))

Visual preference study in 5 Oregon cities.
"Confirms the increasing preference for leaner cuts."

129. U.S. FEED GRAINS COUNCIL (1971)
Meat Production and Distribution in France. II. Pork. S.E.D.E.S. Pt.3, Chap.2, Section 2, p.210.

Survey of 100 housewives in Jan/Feb. 1971. Pork considered not expensive, easy to prepare to which a mediocre prestige is attached. Used because cheaper than beef or mutton. Pork is too fat. Prepared pork (e.g. smoked hams) has more prestige.

130. ZOBRISKY, S.E., LEACH, H., RHODES, V.J. and NAUMANN, H.D. (1960)
Carcase Characteristics and Consumer Acceptance of Light Weight Hogs. Mo.Ag.Exp.Stn.Res.Bull. 739.

90 families in Mexico Mo. and 150 in Jefferson City, Mo., selected by area probability method. Pork sold at reduced prices and asked to rate 9 different cuts. General acceptability not a function of slaughter weight (125-205 lbs).

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