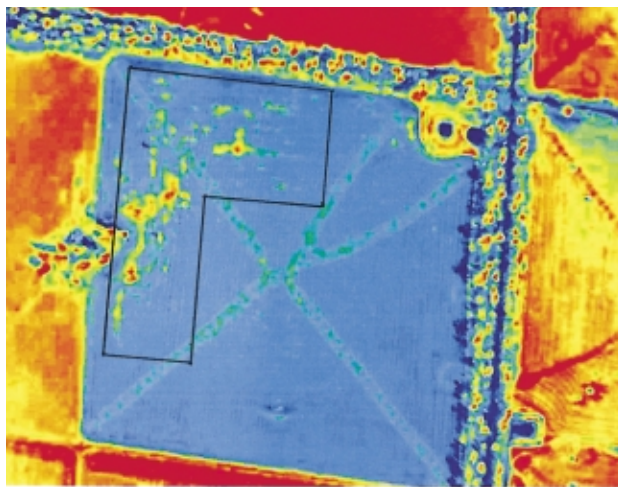


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## Consumer sensory requirements for beef and their implications for the Australian beef industry

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*Abstract.* Consumer sensory requirements for beef vary as a function of the market in which the product is being sold and, within any market, they can vary also over time. These conclusions are demonstrated using the Australian domestic and Japanese export markets as examples. In Australian studies, consumers buying meat for home consumption place more emphasis on leanness than do food service operators, with whom marbling rates more highly. Both household consumers and food service operators rate tenderness as the most important attribute of eating quality for cooked beef. This is followed by flavour. In a restaurant situation, marbled steaks (AUSMEAT score 2–3) have a higher acceptability than for home consumption. In the Japanese market, consumer-purchasing criteria are somewhat more sophisticated but tenderness is again the most important attribute of eating quality. This is perhaps surprising, considering the traditional cultural differences. It suggests that intrinsic factors in the consumer requirements for of beef may be similar worldwide.

### Introduction

The key to success in marketing is to consistently produce what the consumer wants, and to produce it at a competitive price. The Australian beef industry sells product into a large number of markets, and consumer preferences can vary in these different markets. Consumers in any market will have opinions as to what constitutes ‘quality’ (and value). Thus, meat quality is not fixed or absolute.

In any market, there ‘may’ be very well defined traditional aspects that apply to the production, presentation and use of the product. These will affect the attitudes of the local consumers. This can readily be seen when the requirements of consumers in the major markets for Australian beef are compared (Japan, Korea, USA and Australia).

There are 2 stages in the process that results in consumers who are satisfied with quality and, hence, will continue to be customers and regular purchasers of meat. The first stage is visual — the appearance of the product should appeal and result in purchase. The second is the eating experience, which must be enjoyable. To ensure repeat purchase of meat the product must satisfy the consumer requirements at both stages.

This paper will focus on the requirements of the Australian domestic market for beef, including recent trends. In addition, the requirements of Japanese consumers will be contrasted with those of Australian consumers. Most of the information has been obtained from industry reports that are not readily accessible. Their conclusions are summarised here.

It is beyond the scope of this paper to consider either the broader range of factors affecting meat consumption or the relationship of the biological properties of the product to its sensory acceptability. Such material is covered elsewhere, for example in the reviews by Lister (1995) and Dikeman (1996).

### Attributes of beef quality

Consumer criteria for beef quality identify a number of key properties that we will term ‘attributes of quality’. They are:

(i) at retail — visual appearance; i.e. amount and distribution of fat (both marbling fat and subcutaneous or selvedge fat), lean meat colour, fat colour and appearance. The size of the cuts or portions is also a factor in the purchasing decision, but not a ‘quality’ factor.

(ii) at consumption — eating quality or palatability; i.e. tenderness, flavour, juiciness. Cooking aroma may also be a factor in some markets such as Japan.

The term ‘taste’ is also used in this paper, because some of researchers have used that term rather than flavour, presumably because it was more commonly used, or better understood, by consumers. The human tongue has taste receptors for 5 basic taste sensations — sweet, sour, bitter, salty and umami (savory). Flavour can be regarded as a combination of these and odour. Because there are a large number of odours or aromas that can be recognised, there are many different flavours identified by humans.

### Australian consumers

During the late 1980s and early 1990s, there were a number of detailed studies designed to determine the requirements of Australian consumers (Kingston *et al.* 1987; Hearnshaw and Shorthose 1994). The conclusions summarised below were based on these studies.

#### *Raw beef purchasing preferences of consumers*

Australian consumers were asked their preferences when buying fresh beef to be cooked and consumed at home. The responses showed that they wanted steaks to be: (i) lean — about 2 mm subcutaneous fat, and minimal marbling; (ii) light red in colour; and (iii) have white rather than yellow fat (although some thought this irrelevant). In addition, they wanted steaks be medium to large in size, with an eye muscle area from 55 to 82 cm<sup>2</sup>.

Although not an attribute of meat quality *per se*, price was another important factor influencing the purchasing preferences of consumers. While price will affect whether or not consumers will purchase one steak rather than another, some consumers indicated that they were prepared to pay a premium for lean steaks (Hearnshaw and Shorthose 1994).

These workers also investigated the preferences of consumers by surveys of customers who had purchased beef in supermarkets. Packs of steak with various attributes (fatness, size and marbling) were displayed, and shoppers were asked their opinions. These preferences were confirmed by recording the length of time it took for various types of steaks to be sold, both when all steaks were available at the same price, and when there was a price differential (removal rate studies).

They found that, in general, consumers preferred lean (0–2 mm of selvedge or subcutaneous fat) steaks of medium to large size. Overall choice was most influenced by steak fatness, and less by steak size and meat colour. When steaks trimmed to 4 mm or less of subcutaneous fat were presented for sale, factors consistently influencing rate of sale were price per kilogram, subcutaneous fat thickness and marbling. The higher the price, or the greater the fatness and marbling, the longer the steak took to sell. When steaks that were ‘overfat’ were offered for sale, price was not an important factor in determining consumers’ choice, because these steaks were not wanted, at least not at any of the prices offered.

The importance of leanness was further emphasised in a study conducted by SMART (1994), which found that 90% of the reason why one steak was preferred visually to another was due to leanness — less subcutaneous fat, less marbling.

#### *Purchasing preferences of food service operators*

Food service operators buying raw meat for preparation and sale in a range of enterprises, from 5-star restaurants to fast food outlets (MRC 1994a), considered the following attributes to be most important: (i) meat colour, (ii) amount of fat, (iii) amount of marbling (some preferred, with level depending on the type of restaurant), and (iv) fat colour.

In an additional study, MRC (1994b) found that supermarket managers and butchers thought that their customers base their evaluation of raw meat on: (i) meat colour, (ii) amount of fat and its colour, (iii) price, (iv) shape of cut and trim, and (v) freshness and packaging.

Thus, there was some difference in emphasis between food service operators and retailers on the one hand and actual consumers on the other. However, considering all of these studies, fat content emerged as the most important overall factor.

#### *Cooked beef eating preferences*

In terms of a consumer’s evaluation of eating quality, a number of studies have shown that tenderness is by far the most important attribute of cooked beef (see for example SMART 1994). Juiciness and flavour, including a less-fatty taste and texture, were also attributes that influenced consumers. Perceptions of the eating quality of cooked grain-fed beef were identified as being similar in a study by Polkinghorne in 1994. Figure 1 shows the factors contributing to the evaluation of the eating quality preferences of beef by Australian consumers.

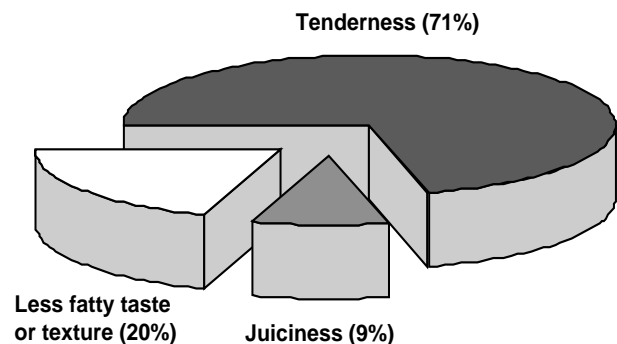
The importance of tenderness was highlighted by the fact that 77% of consumers would be prepared to buy more beef if they knew it was always going to be tender (SMART 1994).

#### *Cooked beef eating preferences — food service operators’ opinions of customer requirements*

As with household consumers, food service operators (McKinna *et al.* 1994a) rated tenderness and taste highly for cooked product. The 4 most important attributes identified by them were: (i) tenderness, (ii) taste, (iii) amount of fat, and (iv) portion size.

#### *Consumer repurchase intent*

Factors contributing to the repurchase intent of consumers were evaluated in the study by SMART (1994). Eating quality was by far the most important (rated as 65%). The other 2 significant factors were price (28%) and product description (7%).



**Figure 1.** Factors contributing to the evaluation of the eating quality of beef by Australian consumers.

### Japanese consumers

A report, 'Winning in the Japanese Beef Market' (AMLRDC/AMLC 1990), investigated the structure of that market. It found that the 'middle market segment' (household and institutional sector) had the greatest potential for Australian exports because, at the time, it made up 65% of the total market. This market segment separated the top end, or luxury market segment, and the bottom end, or manufacturing segment. Customers in this middle market segment were characterised as having broader tastes, but were both price and quality conscious.

#### *Raw-meat purchasing preferences*

To consumers in the middle market segment, the most important attribute of raw beef purchased for cooking at home was freshness. This conclusion was supported by SMART (1993) in a study that found that the date of packaging was the single most important labelling requirement for Japanese consumers.

The most important characteristic for determining liking of appearance of raw meat, whether steak or sliced beef, was the shade of red of the lean portion (SMART 1993). In terms of appearance, Japanese consumers prefer their raw beef to: (i) be light bright red, (ii) have a fine texture, (iii) have a moderate amount of marbling, (iv) have moderate fat cover, and (v) have white rather than yellow fat.

The importance of the colour of the lean component of the steak was attributed to a preconceived perception of freshness. The amount of fat was of only minor importance because all steaks were trimmed to a minimum amount of fat, and the sliced preparations, which make up 70% of beef sold from retail outlets in Japan, are totally trimmed of external fat (SMART 1994). These middle market consumers displayed a preference for slight marbling, as opposed to either no marbling or a lot of marbling, although this preference was dependent on the type of cooking for which the beef was purchased; price was also closely related to marbling.

The price of beef was also of paramount importance to the Japanese consumers. The 1990 AMLRDC/AMLC study reported that consumers tended to prefer beef in the middle price range. Cheaply priced beef was perceived as also being of lower quality.

#### *Cooked beef eating preferences*

When investigating the attributes of eating quality that are important to Japanese consumers, it is necessary to prepare meat in the same manner as it would usually be consumed. The study by SMART (1993) investigated eating quality preferences when beef was prepared as either Teppanyaki style steak (striploin) or sliced Yakiniku preparations (cube roll). The former is cooked much as we would cook steak; the latter is cooked very quickly on a hot plate (similar to stir-fry, but grilled rather than fried).

As with Australian consumers, tenderness was the single most important attribute of cooked beef identified by Japanese consumers. The tenderness was equated with characteristics such as ease of biting and chewing, and fineness of texture. The more of these characteristics meat was perceived to have, the more it was liked.

The importance of juiciness and a familiar strong taste varied with meat preparation, with taste being of much more importance in sliced preparations. Here, the Japanese consumers preferred meat that gave them a strong taste, with a large contribution to this taste coming from the fat component of the meat.

Aroma while cooking was also important. Consumers preferred a familiar aroma, and in this case wanted the smell to be strong. When the odour was unfamiliar, they wanted the smell to be weak (SMART 1993).

#### *Consumer repurchase intent*

The trial run by SMART (1993) was designed so that the consumers: (i) looked at raw meat steaks and slices, (ii) watched it being cooked as Teppanyaki (steak) or Yakiniku (sliced), respectively, and (iii) then ate the meat (up to 6 samples per consumer).

At each stage, consumers recorded what they perceived, how much they liked various features of the meat and how much they were prepared to pay. This provided some understanding of what attributes may be important to their intention to repurchase these types of product. Price was rated at 52%, cooked taste 39%, cooked aroma 5%, raw appearance 3% and other factors 1%. A summary of Japanese preferences for both raw meat and cooked meat, taken from 'Winning in the Japanese Beef Market' by AMLRDC/AMLC (1990) is shown in Table 1.

**Table 1. Relative importance of attributes in the preferences of Japanese consumers**

Relative importance uses a scale of 1 (highest) to 5 (lowest)

Attribute	Relative importance	Key factors
<i>Purchasing for home use</i>		
Freshness	1	Clean package and store; redder meat colour; lighter fat colour.
Country of origin	1	Strong preference for Japanese over imports.
Price	3	Use price as a measure of quality; prefer mid-range prices to high or low.
Marbling	4	Prefer slight, rather than heavy or no marbling, for most dishes.
<i>Eating out or cooking and eating at home</i>		
Taste and smell	1	Fatty, juicy, thick taste; prefer 'familiar' smell.
Tenderness	2	Soft, easy to cut; some marbling.
Leanness	3	Little external fat; little or no marbling except for some dishes.

### Recent developments — Australia

The outcomes of the Australian studies reported above appear to be aligned with current nutritional attitudes to consumption of animal fat, which may be one reason for the slow but definite decline in the per capita consumption of beef in Australia since the 1960s. However, other major beef-consuming countries, such as Japan and the USA, favour marbled beef, and marbling is a criterion in the grading schemes of those countries.

In recent years, there has been a steady increase in grain feeding of cattle for the domestic market in Australia. While it may be argued that this results in an increase in fat content that is contrary to the consumer preference for lean beef, the duration of feeding for the Australian domestic market is generally only 60–100 days and carcass weight has more influence on fatness than method of feeding. A major reason for its use is to minimise the effects of a variable pasture finishing system. However, contrary to the majority of domestic product that is still relatively lean, there is a trend for the food service sector to source product from carcasses of cattle that have been grain-fed for longer periods and, consequently, the beef does have significantly increased fat levels, largely because the cattle are slaughtered at higher carcass weights.

The logic behind this development was borne out by consumer studies in which consumers in a restaurant situation were fed steaks cooked to the desired degree of doneness. The acceptability of marbled steaks (e.g. marble score 2–3) in terms of their eating quality was high (Polkinghorne 1994). In other words, if the fat content was not obvious because of cooking, the (visual) bias against marbling was largely removed and the acceptability was good. Food service operators provide similar information. However, if the same marbled steaks were presented to consumer in a retail display, we can assume that they would be reluctant to purchase the product.

### Meat Standards Australia consumer studies

The consumer studies cited above clearly show that tenderness was overwhelmingly the most important attribute of eating quality and that the reliability or consistency of tenderness of steaks purchased at retail in Australia has been an ongoing problem. This has led the industry, through Meat and Livestock Australia, to develop a beef-grading scheme called Meat Standards Australia (MSA), intended initially for use in the Australian domestic market.

The MSA approach differs in 2 important aspects from previous meat-grading schemes. First, MSA has focused on providing a guarantee of eating quality to the consumer. To this end, it implemented a large testing program, using consumers to evaluate palatability of cooked beef, and the results of this have been used to set the grading standards. It was considered essential to develop a testing protocol that described consumers' eating satisfaction in an accurate and

repeatable manner. Second, MSA has taken a total systems approach to grading meat, in that it aims to control those important factors that impact on meat quality from the production, processing and value-adding sectors of the meat production chain, rather than relying solely on carcass assessment. The MSA grading system is the only one that directly takes account of the effects of carcass processing procedures on meat quality. The MSA grading scheme is based on the principles of Palatability Assurance at Critical Control Points (PACCP). This is a concept taken from the food safety sector. The objective of PACCP is to identify and carefully control those production and processing factors that have the largest effect on palatability so that it is possible to accurately predict the quality of the final product. From a study of the literature and an ongoing research program, MSA has identified those Critical Control Points (CCPs) that impact on eating quality in Australian beef production and processing systems and has combined these into a successful grading system.

### Consumer testing system

The MSA grading scheme uses the consumers as arbitrators of palatability. Consumer panels were used in setting the grade standards, rather than objective measurements, or trained taste panels. Briefly, samples were cooked using a carefully standardised protocol and presented warm to untrained consumers to be scored for 4 sensory dimensions (tenderness, juiciness, flavour and overall liking). To allow the sensory scores to be allocated to grades, consumers were also asked to rate the palatability of the sample using one of the following: 'unsatisfactory' (no grade), 'good everyday' (3-star), 'better than everyday' (4-star), or 'premium quality' (5-star).

### Marbling and eating quality

The relationship between the intramuscular fat content and palatability, as assessed by Australian consumers, has not been extensively studied. However, MSA consumer studies are providing useful information. Table 2 shows that, for striploin samples from carcasses that had been normally hung and aged for 14 days, the effect of marble score resulted in an improvement of eating quality as marble score increased from 0 to 3.

**Table 2. The effect of marbling score on the distribution of animals between the Meat Standards Australia (MSA) grades as assessed by the consumer taste panels**

MSA grade	AUS-MEAT marbling score			
	0	1	2	3
5-star	2	5	8	20
4-star	23	32	56	53
3-star	39	42	27	13
No grade	37	31	9	13

**Table 3. Correlations between AUS-MEAT marbling score and consumer sensory score, within Meat Standards Australia (MSA) grades, for grilled striploin steaks aged for 14 days**

MSA grade	No. of cattle	Sensory attribute		
		Tenderness	Juiciness	Flavour
5-star	167	-0.18	0.36	0.24
4-star	1322	0.02	0.20	0.20
3-star	1646	0.04	0.12	0.11
No grade	1007	0.08	0.09	0.09

Although marbling increased mean palatability score, an increase in marble score alone did not guarantee meat quality. Even the carcasses with a marble score of 3 had a failure rate greater than 10% based on the MSA consumer tests. This reinforces the total systems approach to palatability, which underpins the MSA grading scheme.

These data raise the question as to what components of palatability (tenderness, juiciness or flavour) were being enhanced by the marbling fat. The relationship between marbling and tenderness is variable and may interact with cooking technique and degree of doneness (Dikeman 1996). The correlations in Table 3 suggest that the advantage in palatability from increased marbling may not be due to increased tenderness, but rather to increased juiciness and flavour. In other words, in the situation where grade is not highly correlated with tenderness, but the eating quality of the meat improves (reflected in a higher grade score) marbling is having an effect because of increased juiciness and flavour.

### Conclusions

Studies have clearly indicated that tenderness is the major sensory quality factor affecting Australian beef consumption. Assuming that the tenderness of beef on the Australian market does continue to improve, as a result of the application of the principles used in the MSA grading scheme, other attributes, particularly flavour, may become more important.

Flavour can be varied by the finishing regimen of the cattle, such as the composition of the pasture in a grazing situation affecting beef flavour. As indicated above, the marbling is also important. Thus, there are opportunities for branded product differentiated on the basis of the effect of cattle finishing regimens on eating quality.

It is important that the industry has product suitable for all markets and all market segments. In the Australian domestic market, the requirements of those consumers seeking lean beef must be met. This implies constraints on the time of cattle 'on feed' and/or the proportion of the herd finished on grain. The choice of breeds for particular markets is likely to become increasingly important, e.g. small mature-weight breeds for the Japanese market.

Comparisons of the requirements of Japanese and Australian consumers, made in the early 1990s, demonstrated that Japanese consumers had more sophisticated requirements with respect to their appreciation of beef quality. However, the Australian situation appears to be changing and reducing these differences. Intrinsic factors in the human appreciation of beef may be similar worldwide.

One thing is clear, consumers are becoming more educated, sophisticated and critical in their preferences for beef and other food products. Consistency of product quality will be of major importance but, within that framework, there will be increasing opportunities for product differentiation based on quality attributes attractive to emerging segments of the market. The Australian beef industry faces an interesting and challenging future.

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