THE MAJOR QUALITY FACTORS INFLUENCING OR CONSTRAINING
THE PRODUCTION AND MARKETING OF BEEF

INTRODUCTION

I.P. McCausland*

The Oxford Dictionary definition of quality is "degree of excellence" and for
beef this can, in the final analysis, only be defined by the consumer.

Hence, in our papers we have looked at quality in terms of what "degree of
excellence" can be applied from each of the producers', processors' and
scientists' own point of view. Each has contributed from their own particular
perspective and in respect of those aspects of beef production, processing and
marketing over which they have control. Hence, the producer, who can have a
relatively small influence over "quality" as perceived by the consumer, looks
at the factors affecting "degrees of excellence" in the business of production.
The processor and the scientist do something similar, all seeing the issue from
their own sphere of influence, expertise and experience. It is relevant that
none has given a lot of consideration in their papers to pesticides in beef.
Pesticides never were a real problem in Australian beef - it has always been
among the most pesticide-free beef in the world, despite the media attention
two years ago. Now, after an exhaustive test and clean-up campaign, it is
without doubt the world's cleanest - we in the industry regard this as a clear
plus for Australian beef.

A PRODUCER'S POINT OF VIEW

A. P. Field*

Over the last decade the production and marketing of beef have changed
dramatically. Beef producers are becoming market driven rather than product
driven. At the same time they are becoming more professional in the way they
plan and run their businesses.

Why is this occurring? Because the increased uncertainty of today's economic
climate is forcing the beef industry, like other industries, to become more
competitive in order to maintain an acceptable financial return. Supporting
this change is the fact that information technology is packaging information
and communicating messages more effectively.

The most significant force slowing the rate of change is quality-of-life
considerations. It is the balance between these two forces that determines the
speed at which the industry adopts new methods of production being developed as
a result of research and development in response to market signals.

Therefore, if the beef industry is going to remain viable, and if beef
production is to remain the most financially rewarding use of land, the
industry and the research and development (R&D) community must accept the need
to strike a balance between the following five factors. The first of these is
financial planning. The others are competition for the use of land, optimising
livestock breeding programs, time management and quality of life.

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The most important thing about planning is that you take a long-term view and attempt to anticipate the future. At the same time, it forces people to think out all the alternatives. There are few instances of successful businesses, in any industries, that can sustain growth without drafting a well-researched business plan. It is the business-planning procedure that allows businesses to adapt quickly and remain prosperous in uncertain times.

Whilst business planning is an accepted business practice, it has not been readily adopted. During prosperous and stable periods, beef producers have been able to afford the luxury of storing business plans in their heads and making many decisions in an ad hoc manner. Changes are made to their plans as circumstances require.

Business plans and financial plans will be to the livestock industry what superphosphate has been to the development of pasture, the basis for growth in less than optimum circumstances.

Land use

Livestock production has to compete with numerous other activities for the use of land. Therefore, producers and the R&D community must recognise that livestock production must become more efficient if it is to compete for this scarce resource.

On the positive side, this is a catalyst for change in the industry. Land owners wishing to remain in the livestock industry must adopt improved production methods brought about through R&D initiatives, or risk surrendering, their land to other more progressive livestock breeders or even to other land uses.

Drought management, supplementary feeding, the introduction of feedlots, the use of BREEDPLAN, carcase information feedback and so on, are all components of more efficient livestock production that should assist beef producers to more capably compete for this use of agricultural land.

Livestock breeding programs

Whilst fixed capital (land) has to be more efficiently used, so too does working capital. Livestock breeding programs are where the largest gains in production will be made. Whilst land is a fixed asset and management is based on accumulated skills, livestock production is capable of rapid improvement.

Quality factors influencing change are a myriad of forces surrounding production activities. As mentioned, and in the case of the Darwinian theory, livestock producers who exercise sound judgment in this area will experience the benefits of information technology and research and development initiatives.

There is considerable interest in the livestock production area by researchers. Major initiatives in recent times have been in the increasing use of superior sires by AI and multiple ovulation in superior females. As a result of the latter, highly efficient cows can produce what was previously their lifetimes' production of calves in one year. Splitting of embryos, cloning and sexing of embryos are ways the research community sees the greatest gains being made in this area.

Success will come as a result of getting the big things right and allowing smaller things to fall into line. Accepting the need to incorporate market price signals, recognising the value of incorporating the most efficient
production systems and focusing on the technology available to producers, will all be components of success.

Livestock producers have a capacity to incorporate breeding initiatives made available by computer modelling and NBRS BREEDPLAN. In the past five years this has progressed from an initial focus on growth and milk to the recent introduction of carcase traits. In the next few years fertility data will also assist in making it possible for livestock production decisions to be made on the basis of logic and objective information.

**Time management**

Livestock producers have a strong empathy with their product and therefore it is easy for them to lose perspective. They commonly find themselves carrying out activities that are most urgent rather than most important, e.g. drenching "poor doing" animals rather than taking the time to plan a well co-ordinated herd health program to reduce re-infection of stock and minimise drench resistance.

The introduction of good quality planning techniques with efficient time management will mean livestock producers get the most important activities carried out in an efficient, timely manner. It would seem likely that time management will rank second only to livestock management in delivering major industry gains.

**Quality of life**

Lifestyle is a major consideration in reducing the speed of change and the adaptation of new R&D initiatives. In periods of high interest rates and economic uncertainty, livestock producers are more accepting of change.

Quality of life in the livestock industry is one of the two most important factors driving the livestock production process; the other is financial return. The mid-point of these two forces will determine the speed at which the industry adopts production changes and market signals.

**Conclusions**

As we move into the twenty-first century, acceptance of the benefits of information plus the adoption of quality R&D will be critical to the competitiveness of livestock production. Success will depend on the livestock producers' ability to adapt to aspects or information that enable them to be more efficient and market oriented.

The challenge will be to incorporate components of research and development, with greater reliance on market signals, that will make livestock an increasingly efficient use of land whilst at the same time balance these against the lifestyle needs of producers.

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**A PROCESSOR'S POINT OF VIEW**

**R. A. WHARTON**

First, let us define quality - which, like beauty lies in the "eye" of the beholder. Quality is fitness for purpose. For example, the oldest broken down bull can be transformed into high quality hamburger meat, whereas a younger well-bred and grown steer could yield the highest quality cube roll steak, but would not make high-quality hamburger meat.

The market specification and expectation is widely different in both cases, but each would require, by the market’s definition, high-quality meat.

Market requirements can be split into two broad headings:

1. Specific requirements of the customer

2. Requirements that someone else thinks the customer really wants, or, is going to put up with.

Of course, over time, issues from category 2 move to category 1.

In Australia, we have an industry run body called AUS-MEAT which monitors trade description and quality standards, and the Commonwealth Government Inspection Authority, AQIS, to monitor and supervise health and hygiene aspects. AQIS and industry combine as required to do everything within their limited power to ensure freedom from known deleterious contaminants, but we rely on other people to give us the appropriate assurances. This is one of the problems. Historically, the meat industry has suffered from over-regulation, but this is changing.

Processors survive on a very low margin, so quality maintenance must be done in the most cost effective way. Total Quality Management has been used effectively in this regard, but the wide variation in the types and condition of livestock being offered for sale brings in added complication.

Let’s look at what an abattoir must do sequentially to ensure that a high-quality steak is in the best possible condition to satisfy the consumer and ensure repeat business:

(a) Buy well bred and fed 2-4 teeth steers/heifers without known contaminants.
(b) Arrange efficient "gentle" transport.
(c) Provide watered, comfortable holding yards.
(d) Slaughter and dress cattle without stress in an hygienic manner.
(e) Electrically stimulate carcase.
(f) Refrigerate properly in appropriate manner.
(g) Bone and properly vacuum pack and age for appropriate period.
(h) Maintain correct temperatures and deliver to butcher/restaurant.

Retailers of high quality product can generally be relied upon to present the product properly. Unfortunately, how it is stored, cooked and served in the home is beyond the control of the processor, and his reputation can be damned by lack of attention at this point. Too many people still do not know how to cook properly. The AMLC Right Meat Program is assisting in this regard.

Enough of the present and the past, but what does the future hold in this regard for the processing industry?

"Fututech", a partly automated slaughter and dressing system offers increased hygiene and lower labour costs which will assist the profitability of the industry. Automated objective measurement of carcase attributes and meat quality parameters is currently being addressed as a major issue by AXLRODC.

A breakthrough in the method of boning is expected to result from work currently being funded and directed by AXLRODC. This will also reduce costs.

AXLRODC is aiding further education within the processing sector by funding Meat Diploma students drawn from middle/lower management to enable attendance at Massey University in New Zealand. This will have the effect of upgrading knowledge and awareness of quality aspects and its importance.
It is highly likely that specialised high-quality markets, such as Japan, will continue the trend towards vertical integration with cattle of the desired genetic traits being fed specialised diets for 200–300 days prior to being boned out in the Japanese way (individual muscles excised). The whole operation will be owned by one company.

At the retail level, it is highly likely that butcher shops will become meat selling centres.

More intensive sampling of contaminants and bacteria such as listeria are highly likely future market requirements of overseas countries,

A SCIENTIST'S VIEW OF NEW BEEF PRODUCTION TECHNOLOGY

I. D. JOHNSON*

The production of a higher quality beef carcase demands more attention to detail in the breeding, nutrition, husbandry and marketing of stock. This could readily be achieved in many sectors of the Australian beef industry by the application of current knowledge but it requires the removal of the following constraints:

1. Lack of adequate definition of specific markets.
2. Lack of an adequate carcase description system that reflects carcase quality and specification in relation to specific market requirements for specific markets.
3. Lack of feedback to producers in relation to market specifications.
4. Lack of incentives/premiums to encourage production of a high quality product.
5. Lack of a technology that allows prediction of carcase quality in the live animal.

Some of the marketing constraints are being overcome and have been discussed in other papers in this contract. However, with the increasing sophistication of consumer requirements and the need for beef to compete with a rapidly expanding range of other high quality foods, there is little doubt that marketing systems must be improved to give producers incentives to adopt existing or new technologies that will increase the quality of beef animals leaving the farm.

Lack of product description and feedback in the processing and marketing sectors of the beef industry have contributed to the increasing segmentation of the structure of the production sector, with a decreasing proportion of the cattle turned off farms going for direct slaughter, and an increasing number going through feedlots and pasture-based finishing systems to add "quality" to the final article.

As discussed elsewhere in this contract, quality is a complex collection of parameters and lies largely "in the eye of the beholder". The major feature is consistency of a combination of essential characteristics that appeal to particular consumers, but constancy of supply and value-for-money are also important contributing factors.

For consumers, carcase factors contributing to quality are essentially tenderness, leanness, fat colour, meat colour and, for some markets, marbling, flavour and smell. For processors, high yield would be another attribute of a quality carcase, an important contributor to value-for-money. For some consumers, non-carcase characteristics of beef may also affect their perception of quality; for example, "hormone-free", "grain-fed", "range-fed", "organically-grown".

So which of these quality characteristics can be enhanced by on-farm management? The influence that breeding management and genotype can have on quality parameters will be discussed later.

Tenderness and leanness are primarily functions of age and stage of maturity at slaughter. Tenderness cannot be measured easily in the live animal or carcase, although ultrasound offers some possibilities for the future. Given (a) the overriding influence of age and (b) the importance of pre- and post-slaughter management on tenderness, a technology for measuring tenderness in carcases is of higher priority than in the live animal.

Leanness is of major importance to the producer and processor, and is the only quality parameter for which an optimum range has been defined for each market. In addition, when considered with weight, it is a major determination of saleable yield. Assessment by experienced carcase graders is adequate for many purposes, although knowledge of the carcase composition of the breed type is important. Ultrasonic measurement of back-fat depth on the live animal is now a relatively robust and inexpensive technology and is likely to become commonplace in systems where large numbers of animals are being sold for slaughter, particularly if directed at a market with tight specifications.

Using more sophisticated equipment, Japanese researchers can quantify marbling in live animals using video image analysis of ultrasonic pictures of loin muscles, although this is at present restricted to extreme marbling well above that usually seen in breeds in Australia. Technological improvements in this area are likely to be rapid, and although likely to be expensive in the medium term, the use of sophisticated equipment to screen feedlot animals for propensity to marble on entry to, or after an initial short feeding phase in feedlots, is likely to be available within five years. An alternative "high-tech" solution may be found using gene probes, if marbling is controlled by a single or small number of genes. Once a suitable marker for the gene(s) is found, a relatively straightforward DNA analysis of a blood sample would indicate "carrier" animals. With current technology, such tests would cost $50-100 per animal if markers were available, but again, the cost of this technology is likely to be reduced up to five-fold within the next five years, assuming volume demand. U.S.A. researchers at Texas A&M University are actively pursuing "the marbling gene."

An alternative method of estimating body composition, particularly fatness in the live animal, involves the measurement of the velocity of sound through an appropriate muscle/fat mass, usually in the hind quarter. A commercial device is available in the UK and is currently being evaluated by Australian researchers.

Leanness has traditionally been controlled by the producer by selecting breed, sex and age/weight at slaughter in relation to market requirements, with relatively little control on fat deposition independent of body weight. In controlled feeding situations, dietary manipulation using by-pass protein and
perhaps fat may offer the potential to achieve some separation in the control of fat and muscle deposition in the future, if the results reported in lambs can be achieved in cattle.

These results suggest a similar repartitioning effect on energy metabolism in ruminants previously only seen with naturally occurring and recombinant growth hormone (somatotropin), and various beta-agonists such as Clenbuterol and Cimaterol. Unlike the current generation of hormonal growth promotants on the market, which can promote weight gain under adequate feeding regimes with little effect on the composition of the weight gain, repartitioning agents have the ability to simultaneously markedly reduce fat deposition and promote lean tissue growth.

Recombinant porcine and bovine somatotropins, which are not biologically active in humans, are likely to be registered for commercial use in the USA in 1990, whilst the EEC is still debating its position. The beta-agonists, which are orally-active in humans, are unlikely to be commercially released but have demonstrated the powerful potential for short-term control over final body composition via manipulation of the beta-adrenergic system.

Of course the use of such agents, offering an ability to control carcass leanness and yield to an extent never previously available, would introduce, in the minds of some consumers, anti-quality factors which would completely colour their perception of overall product quality. This concern for naturalness and wholesomeness in the market place has spawned a number of new technological approaches to mimicking the action of the repartitioning agents. These approaches seek to manipulate the endocrine system of ruminants, using immunological techniques that may be acceptable to consumers concerned about residues from exogenous hormonal growth promotants. Whilst none of these is near commercial release, the next decade is likely to see a number of "production-enhancing" vaccines emerging from research into the immunological control of somatostatin, of the biological activity of endogenous growth hormone or of the activity of beta-adrenergic receptors in specific tissues.

The same general philosophy underlies current research into anti-stress and anti-fat cell vaccines: commercial products with the potential for short term manipulation of body composition, particularly during the finishing phase, to allow increased muscle deposition and carcass yield whilst maintaining fat levels within the range specified by the market. Techniques to monitor and to fine-tune carcass composition to meet increasingly tight market specifications will need to go hand in hand.

Meat colour, flavour and smell are quality attributes over which the producer has relatively little control. Fat colour is influenced by genotype, age and nutrition, and is currently manipulated by the composition of finishing rations, with high-grain or silage based rations promoting white fat. The biochemical control of beta-carotene metabolism and fat colour is not well understood, and opportunities for blocking the deposition of specific metabolites may be possible. Modification of flavour and fat composition is currently possible using protected lipid technology developed by CSIRO, but does not appear to be demanded by the market place to any significant degree at this stage.

The increasing consumer concern over product "safety" also impacts on the production of high beef. More rapid tests and sensitive tests for the detection of antibiotics, some chemical residues and spoilage bacteria are becoming available for use in abattoirs to police these aspects of product quality.

The demonstrated ability of the Australian beef industry to implement national trace-back and testing campaigns to eradicate TB, Brucellosis and organo-chlorine contamination has enhanced the reputation of Australian beef and
considerably raised the awareness of producers to the dangers of unintentional product contamination. In the future, the possibility of feeding back a health status report from abattoir meat inspectors to producers, currently under trial in Western Australia, and the development of new vaccines to replace the use of chemicals (buffalo fly, pink-eye) and anthelmintics will further improve the health and quality of Australian beef.

A SCIENTIST'S VIEW OF DEVELOPMENTS IN ANIMAL BREEDING: GENETIC IMPROVEMENT OF BEEF QUALITY

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The production of a higher quality beef carcase has not been an important target for beef cattle breeders in the past, because of the absence of a marketing infrastructure that allowed beef producers to be paid on carcase merit. Breeders have primarily selected stock for live animal traits that they could see, or readily measure, and for which they would be paid when breeding stock were sold. Thus fertility in males received no emphasis until a reasonable correlation with scrotal size was established. The genetic improvement of carcase quality in Australia has been limited to those traits that can be readily estimated in the live animal, namely carcase weight and leanness.

Within-breed selection and cross-breeding have been used by commercial producers to overcome specific carcase problems such as over-fatness, or to enhance specific carcase traits, such as muscling or yield. The increased popularity of cross-breeding in Australia in the 1980s parallels the growing trend for specific markets to demand carcases to specification, and premiums for desired cross-bred stock are now commonplace in many markets. With more than 50 breeds now established in Australia, providing a range in carcase type from Dexters and Jerseys to Chianina and Belgium Blues, commercial producers have access to a large pool of genetic variability to mix and match in a cross breeding program to achieve both an efficient production system for their environment and a final carcase targeted towards specific market requirements. The imminent introduction of a comprehensive carcase description system, increasing segmentation in the market place into specific product lines and increasing "sale-by-description" will stimulate the further adoption of cross-breeding. The beef industry is likely to follow the trend seen in the U.S.A., where greater vertical integration and definition of a quality product have allowed market signals to directly impact on breeding programs on-farm.

Increased market specification and diversification, particularly based on highly competitive, domestic niche markets and small, newly emerging export markets, are likely to be more unstable than the large commodity export markets that Australia has supplied in the past. Cross-breeding provides commercial beef producers with greater flexibility to adapt to changes in market requirements, and contract breeding of speciality dam lines and terminal sire systems are likely to become increasingly common in the more-intensive beef production sector in the future. Seedstock breeders, of course, do not have this flexibility to adapt quickly to changing markets, and must make the difficult decision on which combination of traits, including both live animal performance and carcase quality, are going to be most in demand several generations into the future.

The changes already referred to in the marketing of beef, plus increasing competition from "new" breeds with defined carcase attributes and from crossbreeding, have prompted many breed societies and seedstock breeders to

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begin characterising "genotypes" and sire lines within breeds on the basis of carcase quality traits. A feature of the 1990s will be the progeny testing of sires within breeds on the basis of pre-slaughter and carcase performance, similar to the AUS-MEAT grass-fed and grain-fed feedback trials, and the advertising of sale bulls on the basis of relevant performance parameters and specific carcase traits. BREEDPLAN will provide a very powerful tool to both the seedstock and commercial sectors in this development, enabling animals to be compared and purchased on the basis of EBVs (Estimated Breeding Values) for specific traits, both within and across herds (GROUP BREEDPLAN). Selection indices, providing optimal combination of multiple traits for specific production systems will also be available through the scheme. The first EBVs for a number of carcase traits will become available in early 1990. These will be restricted initially to eye muscle area and fat depth which can be accurately measured on the live animal by ultrasonic scanning carried out by trained operators accredited by the NBRS Scheme. As more comprehensive carcase data becomes available through the efforts of breed societies and other initiatives, more carcase quality traits will be added to the list. These developments will see premiums paid for bulls with high genetic merit for particular traits and the importation and exportation of bulls, semen and embryos between the major beef-producing nations on the basis of a standard evaluation system, as BREEDPLAN becomes established overseas.

It is also likely that feedlots and processors will recommend or supply specific bulls or semen to commercial producers to produce the desired product for specific markets, forming a highly specialised sector of the industry. Once elite, high-value sires have been identified, multiple embryo production by IVF or cloning may become as commonplace in this specialised sector of the beef industry as it is likely to be in the dairy industry. If any of the major quality traits are shown to be controlled by a single gene or a few major genes, gene probes to identify carriers may prove useful, particularly for high-value breeding stock. The application of genetic engineering to improve meat quality is unlikely in the foreseeable future, given the unknown status of the genetic control of the major traits involved, the diversity of trait expression already available with existing breeds (including those overseas) and the cost involved, relative to the likely returns. An exception to this could be the transfer of genes for major regulatory hormones, such as growth hormone, that can indirectly enhance carcase composition, or of completely novel genes that might allow the enhancement of carcase quality attributes in the immediate pre-slaughter/post-slaughter period.

The major limitation to genetic improvement of meat quality in the beef industry, assuming that the marketing and other constraints previously mentioned will be overcome, is the long duration of the production cycle for beef, and the lack of short-term flexibility that will be needed to meet the increasingly demanding, but fickle and segmented, markets of the future. Whilst genetic improvement in beef cattle will be increasingly concentrated on meat quality attributes, the finesse required to refine the final product to meet market requirements and flexibility of production will be provided by the non-genetic management tools mentioned in the previous paper.

SUMMARY

I. P. McCausland

The Australian beef industry provides promotional and research funds, raised by industry levy, which support the activities of the AMLRDC and AMLC. These bodies have improved the "degree of excellence" of beef as a major role and are attacking it from all angles. Promotion and R & D are insufficient by themselves to achieve the big changes now needed - improved market signals from the consumer right back to the producer. The biggest changes here need to be
made by the industry itself - greater acceptance of "over the hooks" selling, objective product description systems, and premium payments based on market specifications. The AMLRDC has comprehensive programs of short and long-term R&D in place to support these changes, but the real change in status quo, with the associated winners and losers, has to come from the industry itself.