Some aspects involved in meat quality

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Introduction

Fundamental to the challenge of meeting market requirements is knowing what the consumer wants. From a number of consumer surveys, various definitions of meat quality and consumer perceptions and preferences can be gathered, and it mainly depends on the market sector and the production system. With this perception of today's consumers' preference for quality, beef quality can probably be defined as comprising four aspects of importance:

- Visual quality: Factors evaluated in classifying carcasses and/or factors that affect consumers' decisions when purchasing meat (e.g. subcutaneous fat cover, bone content and meat and fat colour).
- Eating quality: Tenderness, juiciness, odour and flavour intensity of the cooked product.
- Nutritional quality: Proportions of proteins, vitamins and minerals relative to energy density.
- Safety: Negligible risk from food-borne illness or poisoning and absence of drug, chemical, antibiotic or hormone residues (Dikeman, 1990).

Strategies to improve meat quality

From most consumer surveys, ***meat tenderness*** can generally be regarded as the single most important component of meat quality for the consumer, and therefore the mechanisms involved in manipulating this aspect should be discussed. The rest of the article will be contributed to a short discussion on the factors involved in the other aspects of beef quality, besides eating quality, viz. visual quality, nutritional quality and safety.

Eating quality

First of all, let us define meat tenderness. According to Valin (1995), meat tenderness has always been resolved into two different components referred to as:

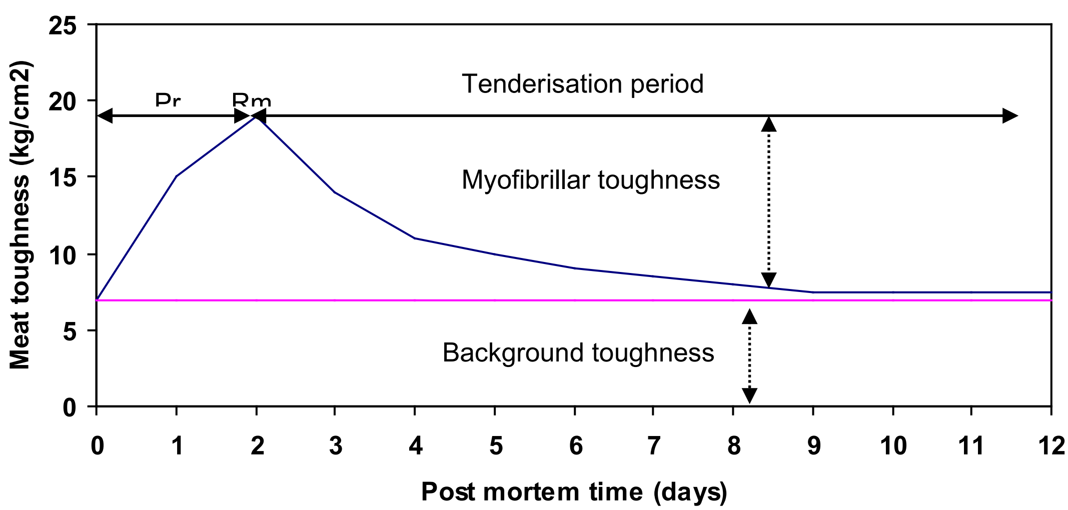
- ***Background toughness***, mainly related to connective tissue attributes (stromal proteins or framework), and
- ***Myofibrillar toughness***, attributed to myofibrillar or contractile properties (Figure 1).

In more simple terms we can compare muscle (meat) with a steel and wooden structure. The frame of such a structure is of steel and almost indestructible. That represents the connective tissue part of muscle that actually strengthens the muscle and keeps it from tearing. The wooden part makes up the bulk of the structure and in muscle represents the myofibrillar part. Wood is destructible, and reacts according to its own intrinsic features **and** external factors. In the same way meat (myofibrillar and connective tissue) react to factors, internal and external, with regard to tenderness.

The connective tissue content and its properties are responsible for about 20 % of variation in meat tenderness. The virtual lack of change in this component during *post mortem* storage while considerable tenderisation occurs otherwise, has led to the conclusion that the weakening of the myofibrillar structure primarily control meat texture (Greaser & Fritz, 1995). The mechanism underlying myofibrillar fragmentation or disintegration of the myofibre structure is the result of the proteolytic action (breaking down of protein structure) of the various enzyme systems (Ouali, 1990;. Roncaleés *et al.*, 1995) in a specific biochemical muscle environment. It has to be mentioned that over prolonged storage of meat + 3 months, unfrozen) connective tissue might also be broken down).

In the conversion of muscle (live animal) to meat (carcass), two phases can be distinguished (Figure 1):

Figure 1: Time course changes in toughness (shear force measurement) of bovine loin muscle from slaughter through 12 days ageing (Pr=Pre rigor; Rm=Rigor mortis)



- During the first phase, *rigor mortis* develops and *post mortem* muscle reaches maximum toughness.
- The second phase is characterised by a gradual improvement in tenderness during *post mortem* storage (Roncaleés *et al.*, 1995). Unfortunately the rate and extent of tenderisation during ageing, especially of beef, are rather variable.

Whilst a holistic approach to meat quality is by far the best, we have to recognise that the efficacy of the whole will depend on the quality of its parts. To this end, considerable effort has been spent and continues to be spent through research on improving carcass and meat quality through genetic and non-genetic strategies.

Genetic strategy to improve muscle tenderness:

It is accepted that ***environmental factors*** (non-genetic/non-animal), such as electrical stimulation, ageing, *post mortem* temperature, proved to have major influences on meat quality especially, tenderness (Ouali, 1990; Olsson *et al.*, 1994; Koohmaraie, 1996)- ***far more than genetics.***

Regarding the ***genetic*** side of meat tenderness, it is firstly accepted that some BREEDS produce more tender meat than others (Koohmaraie *et al.,* 1997**)**. Secondly, and more important, is the fact that WITHIN BREED VARIATION regarding meat tenderness is higher than variation between breeds. Thus, the realized improvement in tenderness from selecting one breed over another is only a small start. To make additional progress within a breed requires identifying those sires (and dams) whose progeny produce more tender meat, either through progeny testing (Phase E) or some direct measurement on the sire and dam to predict the tenderness of their progeny. Unfortunately, nowhere in the world has someone found a reliable method to achieve the latter. Therefore, the only viable option is progeny testing. A number of facts need to be considered with selection for tenderness. First of all, it should be a balanced process, i.e. all other production characteristics should be in place (reproduction, growth performance, functional efficiency). Secondly, the producer has to be sure that environmental factors (non-genetic) influencing tenderness should be well controlled during selection but also when commercialization of meat tenderness(“brand naming”) is put into place. In other words good genetics alone will definitely not ensure high quality meat. Thirdly, due to a combination of low heritability estimates (0.3) for tenderness, relatively long generation intervals (as with many other traits in cattle), and a relatively low selection differential for tenderness, progress will be slow.

However, I am of opinion, that due to the fact that we have never selected for tenderness in South Africa, variation in tenderness with the cattle population might be higher than those of other countries, such as the USA who has made progress in this field. Therefore, our initial progress might be higher, when we start culling the toughest ones and selecting the tender ones, depending on how efficient we can and will select.

Some progress has been made in the field of identifying genetic markers for tenderness, but due to the fact that tenderness (genetically) is a multifactorial aspect (more than one factor involved in tenderness), progress is difficult and slow.

With these limitations in mind, let us look at genotype *per se*. It is well documented that tenderness decreases as percentage *Bos indicus* inheritance increases (Crouse *et al.,* 1989; De Bruyn, 1991; Shackelford *et al.*, 1991, 1995; Whipple *et al.,* 1990, Koohmaraie, 1996)(Figure 2). It has been shown that these differences (between *indicus* and *taurus)* occur due to differences in the properties of the muscle enzyme systems (calpastatin activity) and their effects on the **myofibrillar** properties of the muscle. In simple terms this means that *indicus* meat tend to age slower than *taurus* meat, due to the inhibiting effect of the calpastatin on the ageing process. A very important fact to keep in mind is the interaction between breed and non-genetic factors (see Figure 6)

Cattle indigenous to Africa were often in the past misnamed as *Bos indicus,* based on their phenotype, while Meyer (1984) showed that most of these breeds are more related to *Bos taurus* than *Bos indicus,* and therefore the palatability aspects of their meat should compare favourable with that of Continental and British breeds, as in fact, Shackelford *et al.* (1995), Naudé & Boccard (1973) and Strydom (1998) reported for Tuli, Afrikaner and Nguni cattle, respectively.

Regarding heritability of meat quality traits, Australian research showed that for “tropically adapted breeds” (including *indicus* type breeds) more opportunity exists for genetic improvement than for temperate breeds (British and Continental).

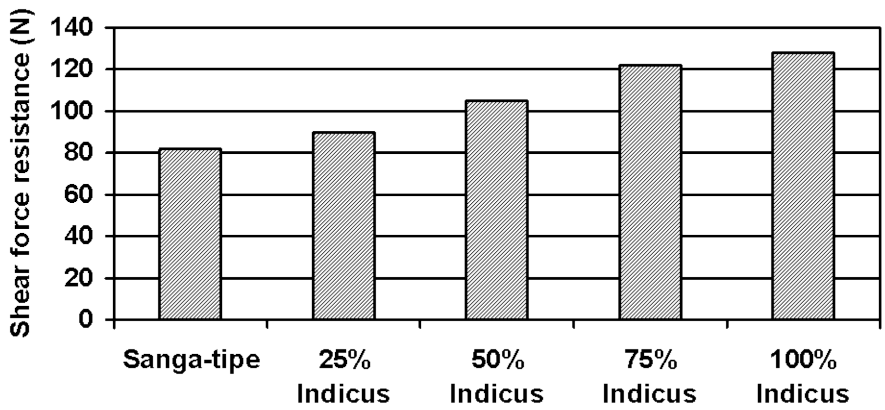


Figure 2: Effect of Indicus blood on muscle tenderness

What is our opinion of “Brand “ names in the meat trade with specific with specific breed names connected to them? Let us first look at the non-genetic factors involved in meat quality.

Non-genetic-strategies to enhance meat tenderness

Age of the animal: In the South African Beef Classification Scheme the influence of animal age has been included as one of the factors affecting eating quality. In a study to re-evaluate the influence of animal age on tenderness of beef, it has been clearly shown that the meat of young animals is more tender than older animals (Figures 3; Crosley *et al.*, 1994) in accordance with the differentiation made in the classification system between A (0 incisors), AB (2 incisors), B (4 and 6 incisors) and C ages (Full mouth). Meat from young animals has “immature” collagen. However, as the animal gets older, covalent bonds (therefore physical bonds) are formed between strands, resulting in the collagen becoming more insoluble, and the meat less tender. Referring to Figure 1, the contribution of background toughness to total toughness of the meat is therefore relatively higher in older animals, than in younger animals. The ***amount*** of collagen is also very important, as it is generally accepted that **collagen is hardly affected by *post mortem* ageing of muscle** (Valin, 1995), hence the term background toughness connected to the characteristics of this tissue (Valin, 1995). This means that animals of higher chronological age (2-3 years and older) can practically not produce meat of similar tenderness to meat from younger animals fed to the same fat level and treated similarly in terms of slaughter procedure and ageing of the meat (NB: the latter part of this statement is very important). However, the myofibrillar part of the meat of an older animal could still be manipulated to produce as tender meat as possible for that specific class.

Gender: Testosterone is also involved in collagen synthesis, accumulation and maturation, which impact negatively on meat tenderness (background toughness; Cross *et al.*, 1984; Seideman *et al.*, 1989). This only come into effect after puberty, meaning that bull meat from young animals (A-age) need not be discriminated against. Morgan (1993) also reported higher levels of calpastatin in muscles of bulls with consequent lower ability to tenderise through the ageing process. Calpastatin is the muscle enzyme that inhibits muscle ageing.

Growth promoting agents: Beta-agonists are one of the most recent approaches to growth promotion in farm animals. The positive effect of beta-agonists on carcass growth performance and carcass yield has been reported for cattle (Fiems, 1987) sheep (Thorton *et al.,* 1985) and pigs (Jones *et al.* 1985). Their effect on meat quality traits such as tenderness turned out to be detrimental for most of these products due to the reduction in the ageing potential (tenderisation) of the muscle *post mortem* (Koohmaraie *et al.,* 1991). Through research alternative compounds (other beta–agonists) have been developed with lower affinity for specific receptors resulting in less pronounced effects on both performance and meat quality. In addition, **optimum inclusion periods** of these products also proved to benefit growth performance without impairing muscle tenderness (Table 1; Strydom, 1998). These are therefore products that need skilful management to ensure optimal financial benefits without harming the quality of the end-product.

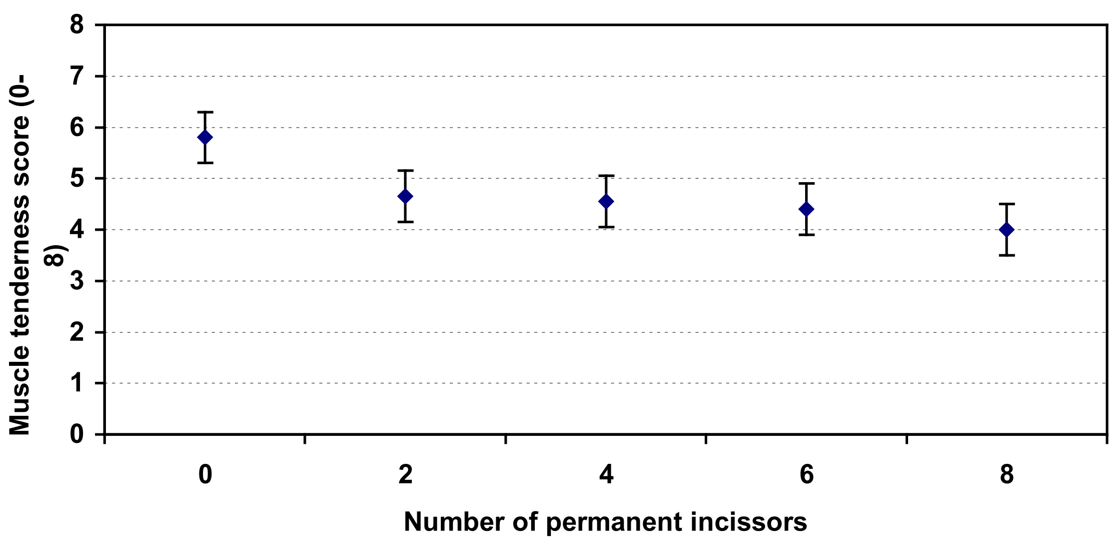


Figure 3: Effect of animal age on sensory tenderness of the loin
(higher scores indicate more tender meat)

Table 1: The effect of different supplementation periods of the beta-agonist, Zilpaterol, on muscle tenderness (shear force: higher values indicate tougher meat)

	Loin (M. longissimus thoracis)				
Trait	***Control***[2]	***Z15***	***Z30***	***Z45***	***SEM***[3]
Shear force resistance (N/25 mm ø)	97.9[a]	114.3[ab]	110.7[ab]	125.5[b]	5.600

[a,b,c] Means in the same row and within the same muscle with different superscripts differ significantly ($P<0.05$; Bonferroni test).

[2] Control received no Zilpaterol; Z15, Z30, Z45 received Zilpaterol for the final 15, 30 and 45 days in feedlot, respectively.

Feeding regime: A lot of debate exist around the quality of beef in relation to what the animal consume. One should however remember that indirect effects might cause differences often believed to be the result of feeding regime. As a general rule of thumb is that rate of growth, rather than feeding regime itself, determines the quality of collagen (background toughness), and therefore meat quality. It is believed that the higher the growth rate, the more young, soluble collagen will form, while higher growth rates will also result in a higher ratio of miofibrillar protein to collagen, which may contribute to tenderness of meat, depending on the slaughter and post-slaughter conditions. According to recent research in Australia (CRC, MLC-report, November, 1998), meat from pasture fed animals were less tender than from grain fed animals, regardless of carcass weight and fatness (Figure 4: three different markets, and all animals less than three years).

According to global literature, the most critical period determining meat quality (especially tenderness) is the 24 hours before and after slaughter.

The results shown in Figure 5, highlight the fact that that tenderness can be affected after slaughter by simple practices such as electrical stimulation and ageing. They also emphatically show that failure to control the post-slaughter environment will allow the condition known ***as cold shortening*** to occur which will give rise to an irreversible toughness. This toughening is only partially reduced through ageing and involves the myofibrillar part of the muscle (see Figure 1).

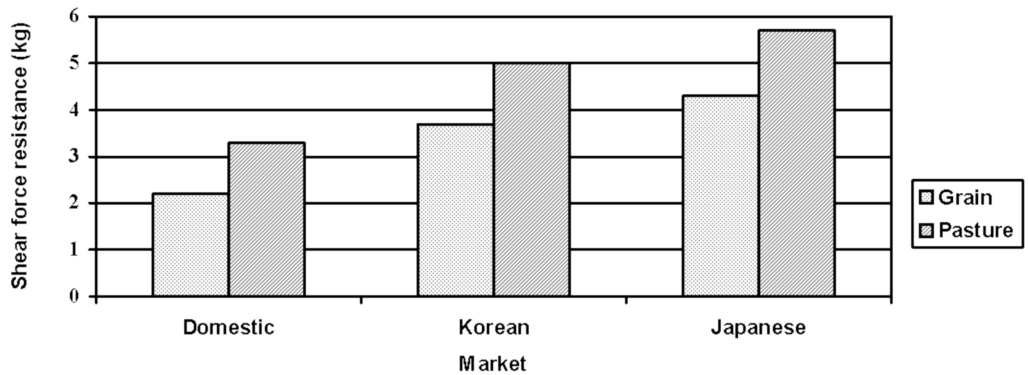


Figure 4: Effect of feeding regime on muscle shear force resistance (tenderness) of different markets (CRC, 1998)(lower shear force, more tender meat)

Cold-shorteing and electrical stimulation (Anon., 1995a): The muscles of a freshly killed carcass are rich in energy and will contract if stimulated, even hours after slaughter. After death, these energy stores are gradually used up, until the muscles finally enter *rigor mortis*. If enough energy stores are present, muscle exposed to chill temperatures below 8°C (common with modern chilling regimes) will slowly and permanently contract. In this "cold shortened" state the muscles become tough meat. Since the need for faster throughput of carcasses, combined with tighter hygiene practice force the slaughterhouses to chill carcasses at these high rates, a procedure had to be implemented to deplete muscle energy soon after slaughter, especially under conditions where carcasses were small and lean (as in South Africa). Electrical stimulation was implemented in abattoirs over the world, where between 2 and 5 A electrical currents at impulses of 10 to 15 pulses per second and voltages between 80 and 800 V are applied over the carcass for 40 to 120 seconds as soon as possible after slaughter, to drain muscle energy *post mortem*. Electrical stimulation is therefore a mechanism to **prevent** toughening of meat resulting from rapid chilling, rather than to promote tenderness. However, electrical stimulation may also mechanically disrupt muscle structure and increase collagen solubility, thereby promoting tenderness *per se.* (review Frylinck *et al.*, 1997).

Ageing of meat has already been addressed under the other headings (breed). Variation in tenderisation through ageing depends on a number of biological factors including animal age, sex-type, muscle type, breed and species, and processing conditions such as electrical stimulation and chilling conditions (Frylinck *et al.*, 1997). Approximately 65 to 80 % of the complete tenderisation process occurs during the first 3 to 4 days *post mortem* (Taylor *et al.* 1995), although extended ageing for seven days or longer will achieve ultimate results in terms of

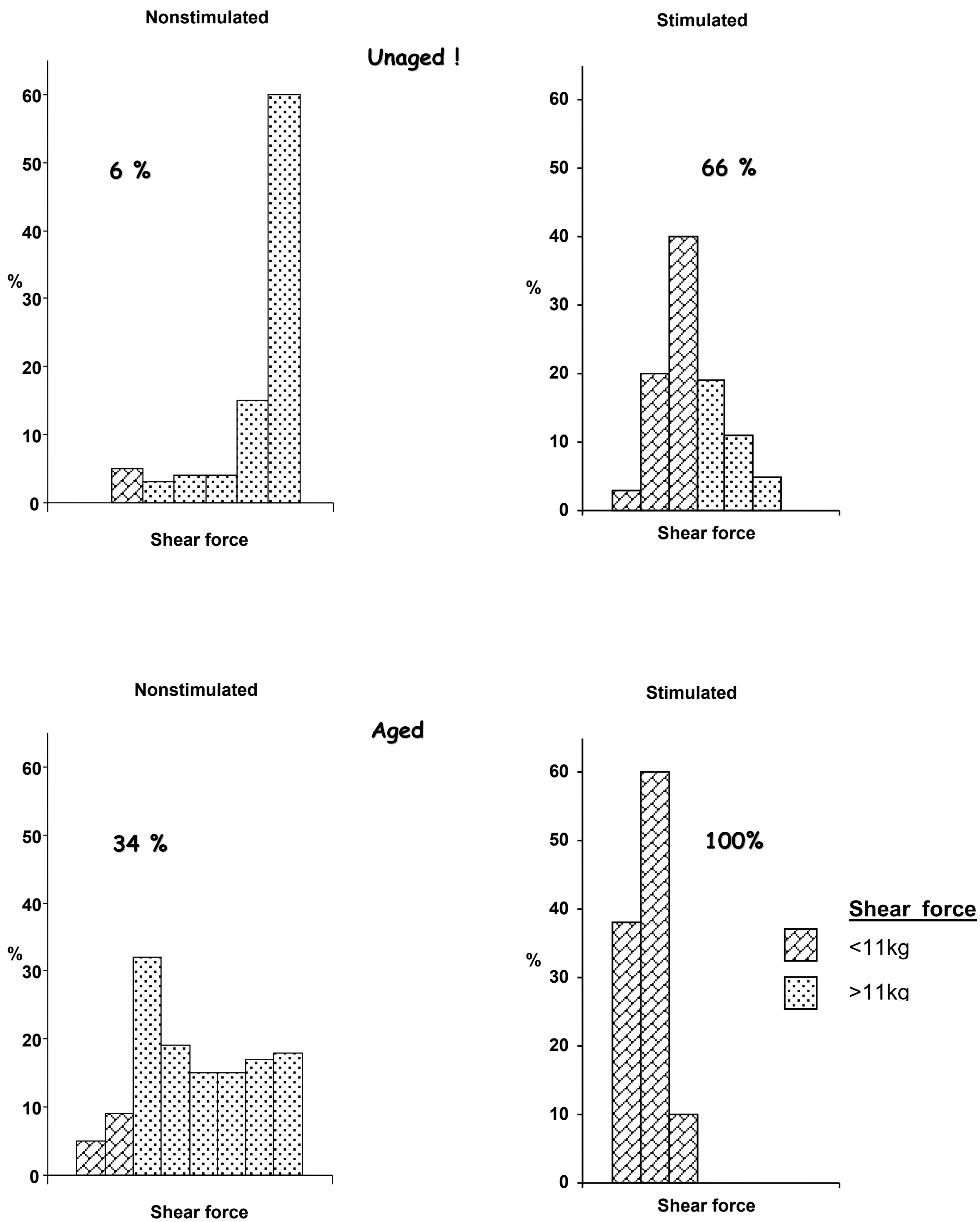


Figure 5: The combined effect of electrical stimulation and ageing on muscle tenderness acceptability (Anon, 1995a)

eating quality. As described earlier, ***genetic/breed*** differences exist for differences in the activity of the different enzymes of this system (Shackelford *et al.,*1991), while Bindon (1997) reported that qualitative trait loci have been discovered for muscle tenderness, probably relating to the enzyme systems involved in ageing. ***Electrical stimulation*** may also enhance proteolysis apart from its function in terms preventing cold-shortening (Smulders & van Laack, 1995; Ho *et al.* 1996). According to a number of reports, reducing the initial rate of ***temperature*** decline after slaughter, improve tenderness through increased rate of ageing (apart from preventing cold-shortening), although to keep to good hygiene practices, caution is advised with such procedures. Practically, this means that electrical stimulation is not necessary if initial chilling rate is low, but abattoir hygiene practice should be at a very high level before such a practice is considered.

Figure 5 demonstrates the combined additive effect of electrical stimulation and ageing. In New Zealand, shear force resistance of beef were tested against consumer acceptance and meat with a shear force of 11 kg or less was found to be acceptable by consumers. According to the different graphs, electrical stimulation on its own (no ageing), could increase consumer satisfaction by 60 percentage units. Ageing without stimulation only gave acceptability rates of 34%, while both electrical stimulation and ageing increased acceptability in terms of tenderness to 100%.

Recent work in South Africa confirm these findings on local grounds, indicating an effect of 12 to 18% for electrical stimulation and 6 to 12% for extended ageing (10 days) on meat tenderness of the loin muscle. These are not fixed values, but is surely significant enough for consumers to detect. Limited information about an average sector of the South African consumer (not specified) show that a 12% variation in meat tenderness could result in a 15% shift in consumer acceptability (satisfaction) of tenderness.

Factors involved in visual quality of beef

Stress or exhaustion of animals prior to slaughter (Anon., 1995b): Dark, firm and dry meat is associated with the slaughter of exhausted animals. Normal muscle end-pH (acidity) is about 5.5 (when rigor mortis is completed) as a result of adequate glycogen converted to lactic acid *post mortem* (pH=7 at death). In stressed animals the energy reserves are depleted, resulting in higher final pH values (pH>5.8; lower acidity) than muscles of animals slaughter in an optimum energy state, because less or no glycogen is converted to lactic acid. The muscles look black, are very firm and retain water, hence the term dark, firm, dry meat DFD). Meat is less opaque at higher pH values, resulting in less light reflection. In addition the oxygenated oxymyoglobin pigment giving meat its red colour is thinner, while muscle also become more hydrated at higher pH values.

Exhaustion is seldom physically detectable in the live animal, but is usually the result of:

- prolonged fasting times (withdrawal of feed prior to slaughter),
- extreme temperatures,
- stressful handling procedures during the 48 hours before slaughter, including transport practices,
- certain growth promoting agents can potentially increase DFD,
- gender (Figure 6) – young bulls are more prone to stress and exhaustion than other sexes,
- breed of the animal combined with its temperament.

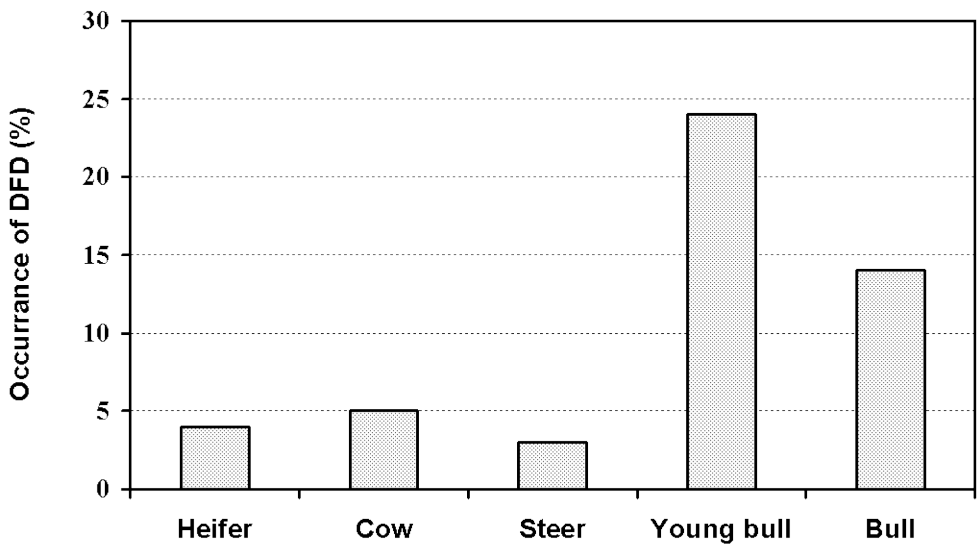


Figure 6: Occurrence of DFD according to gender

Very often a combination of all above mentioned factors result in DFD. This knowledge enables the producer and abattoir to adopt procedures to limit stress to a minimum.

Problems caused by DFD meat are (Anon, 1995b):

- Consumer rejection on the grounds of colour, associating the dark colour with old animals or meat that has deteriorated
- DFD meat is sticky, it has a changed flavour profile and can even be tougher at moderate levels of increased pH.
- DFD meat spoils earlier especially in vacuum packs due to specific organism proliferating at these high pH values and low oxygen levels.

Pre-purchase: Consumer opinion and methods to attract and satisfy consumers on solid facts (not gimmicks) has not always been the meat industry's concern in South Africa. However, over the world there is an increasing change from a "industry/technology push" to a "consumer pull" in the attitude towards the whole production process and South Africa should be no exception. Certain niche markets are currently taking up existing technology and apply it for the sake of the consumer's demand. If the safety of a product (microbiologically and residues) is accepted as the norm, visual appeal of meat, besides price, is the one of the most important aspect governing pre-purchase preferences of the meat buyer. The ***amount of fat*** in this regard has already been discussed. The other aspect of importance is ***meat colour shelf life*** that goes hand in hand with microbiological shelf life. Since muscle colour is also influenced by its microbiological status, good managing practices in this regard is obvious.

Other manipulations have also been used to assure extended shelf life in terms of appearance. MAP or modified atmosphere packaging, is an alternative packaging method where the conventional polystyrene tray with over-wrap film is substituted with a packaging method where meat is in an atmosphere environment of up to 70 % oxygen, to help the meat retain the bright red colour of oxymyoglobin. Twenty to thirty percent carbon dioxide is added to retard bacterial growth and the remainder is made up of nitrogen as a ballast to maintain the shape of the display pack. It is claimed that this packaging method extends the shelf life approximately two-fold, with obvious logistical advantages and reduction in waste. MacDougall & Taylor, 1975 found that oxygen enriched atmospheres has increased colour shelf life relative to that for beef stored in air, such that meat of intrinsically poorer colour stability demonstrated a greater increase in shelf life compared to meat of better colour stability.

Another method used to extend shelf life in terms of colour, is supplementation with Vitamin E. The advantage gained through this method is primarily due to the incorporation of Vitamin E into the cellular membranes, where it acts as a lipid soluble antioxidant, limiting pigment oxidation and therefore improving colour stability (Taylor *et al.*, 1994). It has been estimated that increasing the colour shelf life of beef by two days would potentially save the retail beef industry US $ 800-1000 million annually (Faustman & Chan, 1994). A minimum of 0.3 mg alpha-tocopherol/100g tissue was necessary to obtain an anti-oxidant effect on muscle according to these researchers. Arnold *et al.* 1992 reported a 2 to 5 days extension of colour shelf life for fresh beef from Vitamin E supplemented steers, while Taylor *et al.* (1994) reported an increase in colour life of MAP beef from 11 to 21 days for beef supplemented with 2 500 mg of Vitamin E for 40 days.

It should be remembered that none of these methods can be used successfully if basic hygiene and chilling procedures (ultimately HACCP) are not in place.

Fat colour is yet another issue that may influence the buyers choice of meat. Yellow fat is less acceptable to consumers than pure white fat (Harrison *et al.* 1978). In South Africa, price discrimination against yellow fat may range between 20c per kg to 50c per kg, depending on the market (Personal communications, Viljoen, Department of Agriculture, Kwa-Zulu Natal, 1998).

Yellow fat is commonly attributed to extended periods on succulent grazing, and is a result of natural plant colour pigments, beta-carotene, that accumulates in the subcutaneous fat of the animal. According to Forrest (1981) and Strachan *et al.* (1993), grain feeding for periods between 5 to 8 weeks is sufficient to improve fat colour to an acceptable white colour. Besides feeding regime, genetics, gender, age and chilling rate of carcass were found to have an effect on the visual quality of fat.

No evidence could be found that fat colour influences flavour or nutritional quality of meat and therefore education in this regard is needed to overcome the perception of the consumer that meat with yellow fat is inferior.

Food safety

Consumers expect food to be safe. Outbreaks of meat-borne illness, particularly when well publicised can harm the meat industry for a long time. Once lost, consumer confidence is difficult to regain. One may think that food-poisoning incidents/scares (such as E.coli in the USA) does not affect the South African consumer. However, from the Government’s RDP and GEAR programmes it is clear that safe, sound and wholesome food to all, at an affordable price, is considered a constitutional right. Ideally the meat industry should completely eliminate every microbial menace threatening the safety of eating meat. Practically, this is difficult to achieve and the traditional meat inspection practices largely prevent meat from *diseased* animals entering the human food supply. However, they do not prevent meat being contaminated with enteric pathogens which is carried by asymptomatic animals. Similarly traditional regulatory food control is based on observation and "testing" of samples after processing; the main emphasis being on spoilage. This system is retroactive and gives little or no health protection. The closest we can come to eliminating risks is through the application of Hazard Analysis Critical Control Point (HACCP)(Anon., 1997). HACCP is defined as "a system that identifies, evaluates and controls hazards that are significant for food safety." It is the only way that industry can take preventative measures for on-line process control rather than keeping food safety standards by detection of the final product. Although the producer may not feel directly involved in this part of the process, he must remember that the quality and image of the final product, meat, will in the long run affect his operation. Therefore, he should be at least contribute to this part of product quality by assuring the health status of his animals and to select abattoirs who's slaughtering practices will add value to his slaughter animal.

Nutritional quality

Meat is a primary dietary component and forms an important part of a balanced and varied diet (Kauffman & Breidenstein, 1983). The nutritional attributes of meat, which provide a major proportion of consumer requirements for protein, some vitamins and certain minerals, are highlighted work on the nutritional value of meat in other countries (Breidenstein, 1987; Johnson, 1987). The nutrient profiles of meat have been updated in Australia (Johnson, 1987), United Kingdom (Chan *et al.*, 1995) and more recently in the United States of America (USDA, 1997) and South Africa (Schönfeldt, 1998). This ensures consistency with changes in carcass characteristics, retail and food preparation practices and provides additional information. A much needed database of the nutrient content of beef is now available for medical personnel as well as the normal consumer to make an informed decision on diet composition (Schönfeldt, 1998). Even so, red meat is still perceived as unhealthy and much needs to be done in terms of education and promotion to change this perception.

As iron-deficiency anaemia is the most widespread nutritional disease in the world today, it is reassuring to know that the meat mostly consumed by the people with severe iron-deficiency anaemia in the rural areas of South Africa, are adequate to meet this need. Red meat is also an important source of the following vitamins and minerals (% of RDA in a 200g boneless cooked portion for males): thiamine (15%), ribofvlavin (12%), niacin (48%), vitamin B6 (20%), vitamin B12 (107%), zinc, phosphorus, copper (Anon, 1998).

Since particularly saturated fatty acids are associated with coronary heart disease, it makes sense to limit fat intake to responsible levels. There is a misconception that foods of animal origin contains mainly saturated fatty acids and for this reason should be excluded from a healthy eating plan. In fact all fats, whether of animal or plant origin are mixtures of saturated, monounsaturated and polyunsaturated fatty acids. Beef contains about 40% saturated fatty acids, while the remainder are mono- and polyunsaturated. The latter are known to have a neutral or positive effect on coronary heart disease. Another little-known fact is that one of the saturated fatty acids contained in beef does not have any of the cholesterol-raising properties of the other saturated fatty acids. It is therefore called a cholesterol-neutral fatty acid (Anon, 1998).

Cholesterol is a substance produced by the body but is also absorbed from any foods of animal origin. It is a substance that is needed for normal functions of the body cells and brain. Although raised blood cholesterol levels are associated with an increased risk of coronary heart disease, the amount and type of fat intake plays a more important part in the risk than does the intake of cholesterol in the diet. The Heart Foundation of South Africa recommends that a total of 300mg of cholesterol be consumed daily. From research on South African beef, it was shown that a serving of 100g of cooked, boneless lean beef provides less than one third of this recommended intake (Anon., 1998)

It is therefore clear that there is lot of information available that can be used to increase the downward trend in red meat consumption.

Final quality: The cooking process

Failure to deliver steak to ordered degree of doneness (that is, rare, medium and well done) was recently highlighted as major source for client dissatisfaction in a Meat Research Corporation study in Australia (Bindon, 1997). In this study, one third of the consumers believed that their steaks were not delivered as ordered in terms of doneness.

Overcooking can of course ruin months of effort that has been put into the production of a tender, healthy steak. A general rule of thumb that demonstrates the disadvantage of overcooking is that meat toughness will increase by approximately 100% when the final internal temperature of meat increases from 60°C (rare) to 80°C (very well done).

Conclusion and recommendations

While this discussion only deals with the tenderness part of meat quality, other factors involved in a safe, healthy tasty piece of meat with good visual appeal should not be forgotten in a well organised and co-ordinated effort of production. So let us ask a few questions again: Is "brandnaming" a sensible approach to improving the image of Red meat in general and that of the specific role-player in general. Yes, if the proprietor of such a Brandname is sensible enough to realise his responsibility to total quality management (TQM), i.e. each step of the production chain, from genetics through the keeping, treating, transporting, feeding, slaughtering and post-slaughter procedures, display and presentation of cuts, the cold chain and up to informing the naïve consumer what cut to use for specific preparation methods and how this meat should be prepared. That means that a NAME of a company, feedlot, geographical area, breed name etc. will not sell on its own because it does not guarantee consistent meat quality.

Lastly, considering the information (although limited) provided in this article, no breed society could claim that their meat is more tender than that of other breeds, as the variation in meat tenderness could depend 90% on slaughter and post-slaughter conditions and procedures. One good example of this involves the Brahman, where genotype and slaughter procedure interacted wit one another. According to Figure 6, 80 to 100% Brahman gave significantly less tender meat compared to the other Brahman crosses when no electrical stimulation (ES) was applied. However, by stimulating the carcasses the variation between the 80/100% crosses and the other crosses was minimised (NB: this experiment is a first and was no repeatability was proven). Therefore a procedure like ES could be more effective when the intrinsic tenderness of meat is low.

My advice to any organisation that wants to brand its meat:

1. Focus on TQM.
2. Do not promote your product to the detriment of the rest of the red meat industry is, i.e. use positive ideas to promote red meat – do not focus on what the other producers do not achieve or do wrong – that kills the image of red meat
3. Focus on consistency, because one "bad experience" could potentially multiply into a loss of 800 customers according to USA data.

Remember

"customers vote with their feet"

and

"

Quality is never an accident:

it is always the result of

high intention,

sincere effort,

intelligent direction

and skillful execution.

It represents the wise choice of many alternatives"

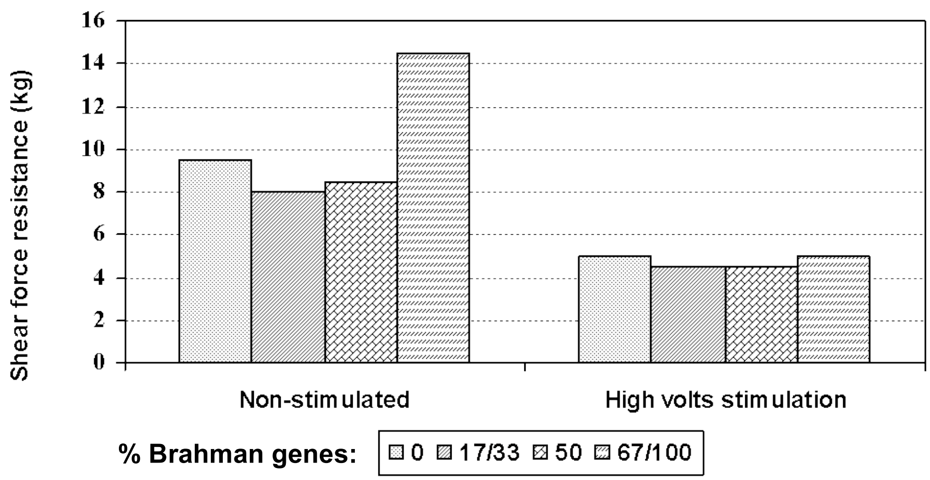


Figure 6: Effect of % Brahman genes and electrical stimulation on muscle shear force resistance (tenderness)

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