MEAT QUALITY:

How does hump height play a role?

Dr Phillip Strydom
Research Team Manager: Meat Science, Animal Production Institute - Agricultural Research Council of South Africa
PStrydom@arc.agric.za | 012 672 9340

The eating quality of beef is a function of production, processing (meaning slaughter and related procedures), value adding (aging of meat or other treatments) and cooking method used to prepare meat for consumption. In most cases no specific attention is given to these processes with undistinguished beef, but quality assurance programs (QAP's) and brand names pay particular attention to detail in making sure that the right boxes are ticked at least for the first three processes. It then remains the cook's responsibility not to mess up the effort of the previous 12 months or more.

There are various so-called critical control points (CCP's) used to make sure that the best eating quality can be guaranteed by the time the meat ends up on the shelf. In the production process these may include breed/genetics, growth path and growth stimulants. Stress, the conditions (pH and temperature) under which muscle is converted to meat (first 12+ hours after killing) and post-mortem aging are the CCP's involved in pre-processing, processing and value adding. Many of these CCP's are interrelated, for example, genetics or the use of growth promoters may influence the aging process and may determine how long the aging process needs to be.

Of the various palatability traits of meat, tenderness is mostly regarded as the most important, is complemented by flavour and juiciness. Tenderness is also most affected by CCP's used by QAP's.

Most QAP's discriminate against or issue penalties for carcasses from *B. indicus* derived cattle, sometimes incorrectly referred to as tropically adapted breeds. There is myriad evidence to support such penalties, although many studies also show that genetic variation do exist for tenderness within breeds. In countries like South Africa, the USA and Australia (40%), *B. indicus* derived animals comprise a large portion of the cattle herd. *B. indicus* derived cattle generally produce carcasses showing less marbling, less tender meat and more variability in meat tenderness than other breed types. Different studies found that the magnitude of the effect of these breeds varies, with some showing effects when as little as 25% *B. indicus* content was present, while on the other extreme, some showed that even 75% *B. indicus* content is required before consumers can detect differences in palatability. As explained earlier, other CCP's may contribute to the outcomes of *B. indicus* content, hence the variation in the impact. Very generally speaking, the negative effect of *B. indicus* on meat tenderness can be explained by high activity inhibitors, called calpastatin, against the action of proteolytic enzymes responsible for tenderisation during aging of meat.

It seems that magnitude of the impact of *B. indicus* content on tenderness or palatability is muscle dependent. Studies do not always have consensus on which muscles are affected except for the fact that the muscles surrounding the spinal column always show the most significant results. These will include cuts in South African terms such as the strip loin/porterhouse/sirloin, rib eye and sometimes the fillet. The MSA-grading scheme of Australia takes numerous factors into account to calculate a palatability score, or MSA index. The

scheme ranks carcasses (palatability by sorting them into "ungraded", "3-star", 4-star" and "5-star" quality grades. Because this system grades carcasses on a cuts basis (not whole carcass), the three cuts mentioned will on average show a 10-point decline over the range of 0-100% *B. indicus*. It is therefore important to note that a single adjustment of quality score for % *B. indicus* across all muscles (i.e. on a carcass basis) is inappropriate.

So, considering the significant effect of *B. indicus* content on palatability, it seems that it is important to be able to quantify the amount of *B. indicus* in a slaughter animal. But how is this detemined if the animal is not pure Brahman, for example, and where does hump height come into the picture. In some grading systems such as MSA, *B. indicus* % is verified by producer declaration, in other words the producer will state on the pre-slaughter form the % *B. indicus*. However, because of the distinctive hump of *B. indicus* derived cattle, hump-height is also recorded during post-harvesting assessment in carcass chillers or on the slaughter line. When the hump height is outside a specific range for the declared *B. indicus* %, an additional (i.e. negative) *B. indicus* adjustment is applied on the MSA index. This, they claim, provides improved accuracy for scoring some adapted *B. taurus* breeds such as the Belmont Red (mainly Afrikaner, Hereford, Shorthorn with some *B. indicus* genetics).

There is not always consensus on the specifics of hump height to discriminate between tender and less tender. As demonstrated MSA, does not disqualify carcasses on the grounds of exceeding a certain hump height, but other QAP's do. The MSA use the combined declaration of % *B. indicus* and hump height to calculate the MSA score. Typically, between 0% and 100% *B. indicus*, as stated by the producer, the MSA index (0-100) will decrease by 6.3 units (a penalty), while for each 10 mm increment in hump height for an animal with more than 0% *B. indicus*, an additional 0.7 units will be deducted on the index. Other brand and grading systems use a different approach. Out of 52 USDA branded beef programs in the USA, 50 include hump height as one of the criteria among others such as the use of growth promoters, electrical stimulation of the carcass, time on feed, marbling, meat colour and others. They disqualify carcasses having hump heights exceeding as little as 25 mm. This is extremely harsh, while Woolworths in South Africa exclude carcasses from their Free Range Brand with hump heights exceeding 90 mm. They claim that this ensures that no more than 50% *B. indicus* animal content is allowed. This assumption is probably adopted from the MSA-system. A typical MSA result on grading will regards 120 mm hump as 100% *B. indicus*, 90 mm as 50% and <45 mm, as o% *B. indicus*. It seems that it is only the MSA grading system that takes carcass weight into consideration when adjusting MSA index scores against hump height. This is of course correct as hump height may be a factor of carcass weight. It must also be emphasised that the MSA system does not downright disqualify carcasses with higher *B. indicus* content as other factors such as growth path, lack of using growth promoters, longer aging of meat and other practices during slaughter may add to the MSA index of such carcass placing it into an acceptable category.

FIGURE 1: *Boran Carcasses with humps*

It seems that it is only the MSA grading system that takes carcass weight into consideration when adjusting MSA index scores against hump height. This is of course correct as hump height may be a factor of carcass weight.

Another USA study investigated the use of marbling score, hump height and certain muscle colour parameters to improve the conventional USDA grading system that is based primarily on marbling score, fatness and maturity (ossification score). They found that hump height explains 8% of the variation in overall palatability of a number of muscles combined. This figure is quite low considering the effect of other factors such as marbling (12%), muscle pH (an indication of stress; 15%) and muscle colour lightness and redness (21% and 23%). Like Woolworths they used 89 mm hump height as benchmark to sort carcasses according to palatability differences and proposed a grading system with this value as criteria for hump height and certain values for muscle colour and amount of marbling as well.

Trusting the producer to provide the proportion of *B. indicus* could potentially be risky. Therefore, some research done in Australia investigated the accuracy of hump

height measurement to predict the amount of *B. indicus* content. They found accuracies between 40 and 70% of which the latter is quite substantial. When this was used to group cattle types correctly into known genetic groups containing various levels of *B. indicus* content, the most success was at the extremes, i.e. 100% and 0% *B. indicus* (Table 1).

indigenous humped breeds may have hump height values higher than 90 mm in which case a grading system such as MSA will regard the animal as having 50 % *B. indicus* content, while Woolworths Free Range will fail the animal as being non-compliant with specifications. This will be an unfair and incorrect verdict.

TABLE 1: *Classification accuracy for percentage B. indicus content (epbi) as estimated from hump height and carcass weight. Overall: n = 23 493; n correct = 17 671; proportion correct = 0.752 (Watson, Polkinghorne, and Thompson, 2008)*

Predicted group	True group				
	Z	L	M	H	F
Z (zero epbi)	14 474	628	359	118	13
L (low epbi)	742	1067	636	55	24
M (moderate epbi)	191	264	329	234	26
H (high epbi)	441	604	477	361	477
Total *n*	15934	2666	1986	27	1980
n correct	14474	1067	329	361	1440
Proportion correct	0.908	0.400	0.166	0.389	0.727

0% *B. indicus* and 100% *B. indicus* content were 90.8% and 72.7% correctly estimated, respectively, while for 50% *B. indicus* only 16.6% was correctly estimated against known records of *B. indicus* content.

Cited material:

Watson R, Polkinghorne R, Thompson JM (2008) Development of the Meat Standards Australia (MSA) prediction model for beef palatability. Australian Journal of Experimental Agriculture 48, 1368–1379.

FIGURE 2: *Measuring of hump height*

Hump height is measured as the distance from the dorsal edge of the ligamentum nuchae to the maximum dorsal protrusion of the rhomboideus muscle, not including subcutaneous fat.

Considering the scientific evidence, hump height seems to be a fairly valid method to be used as a physical measurement of the amount of *B. indicus* content in cattle and therefore the magnitude that this effect (genetic) may have on meat palatability. One concern in the local industry is that there is no evidence to show whether