MEAT QUALITY: How does hump height play a role?

PHILLIP STRYDOM
PROFESSOR: DEPARTMENT OF ANIMAL SCIENCES
FACULTY OF AGRISCIENCES, STELLENBOSCH
UNIVERSITY | PESTRYDOM@SUN.AC.ZA

The eating quality of beef is a function of production, processing (meaning slaughter and related procedures), value-adding (ageing 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 (QAPs) 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 (CCPs) 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 ageing are the CCPs involved in pre-processing, processing, and value-adding. Many of these CCPs are interrelated, for example, genetics, or the use of growth promoters may influence the ageing process and may determine how long the ageing process needs to be.

Of the various palatability traits of meat, tenderness is regarded as the most important and is complemented by flavour and juiciness. Tenderness is also most affected by CCPs used by QAPs.

Most QAPs discriminate against or issue penalties for carcasses from Bos 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 does 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 is 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 CCPs may contribute to the outcomes of B. indicus content, hence the variation in the impact. In very basic terms, the negative effect of B. indicus on meat tenderness can be explained by the high activity of inhibitors, called calpastatin, against the action of proteolytic enzymes responsible for tenderisation during the ageing of meat.

It seems that magnitude of the impact of B. indicus content on tenderness or palatability is muscle dependent. Studies do not always reach a 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.

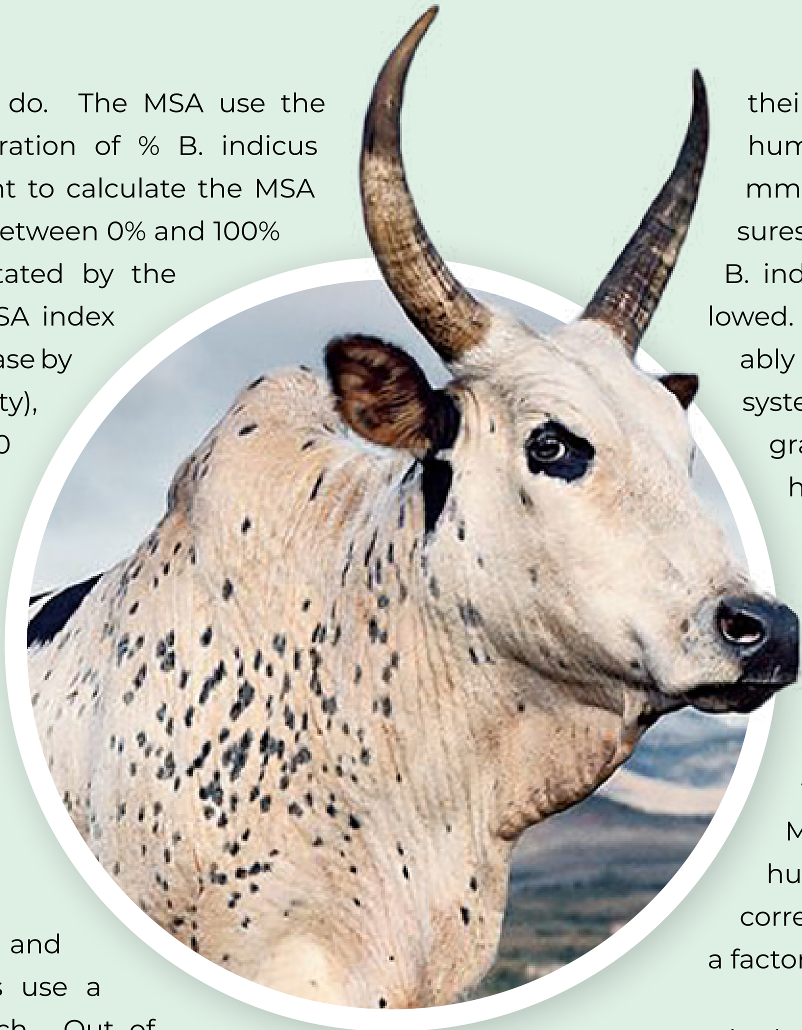
The MSA-grading system of Australia takes numerous factors into account to calculate a palatability score, or MSA index. The scheme ranks carcasses (palatability by sorting them into “ungraded”, “3-star”, 4-star” and “5-star” quality grades. Because this system grades carcasses based on cuts (not whole 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 slaughtered animal. But how is this determined 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 percentage (%) 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 to 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 QAPs 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 brands 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 exceedingly 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 regard 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 considers carcass weight 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 ageing of meat and other practices during slaughter may add to the MSA index of such carcass placing it into an acceptable category.

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 several 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 a 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.

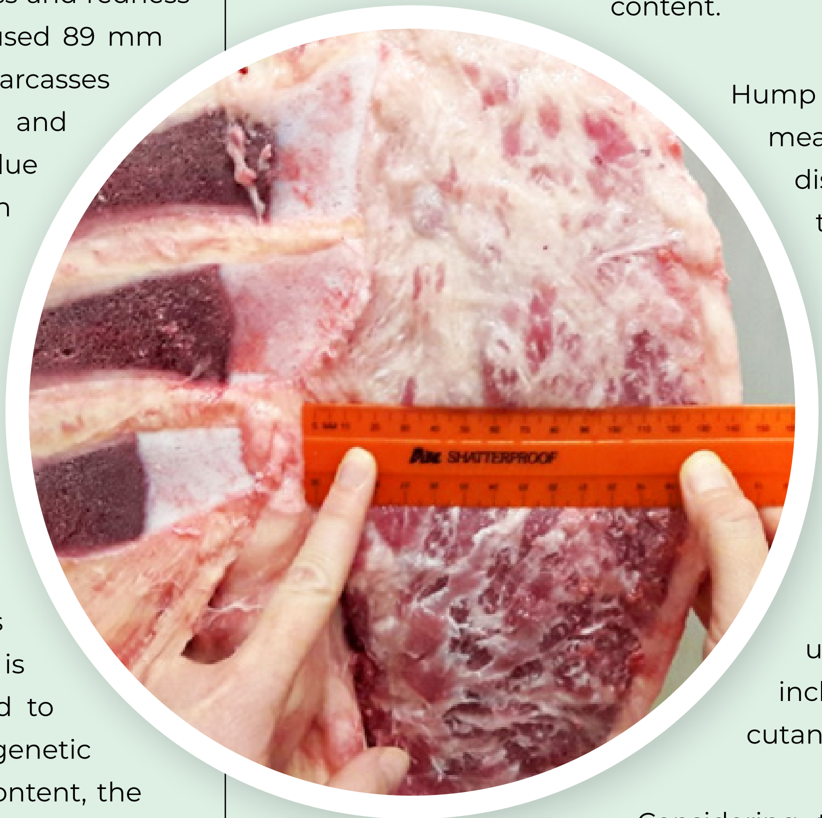
Trusting the producer to provide the proportion of B. indicus could potentially be risky. Therefore, some research done in Australia investigated the accuracy of hump height measurement to predict the amount of B. indicus content. They found accuracies between 40 and 70, of which the latter is quite substantial. When this was used to group cattle types correctly into known genetic groups containing various levels of BI content, the most successful was at the extremes, i.e., 100% and 0% B. indicus (Table 1).

Table 1: Classification accuracy for percentage Bos 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			**TRUE GROUP**		
GROUP	**Z**	**L**	**M**	**H**	**F**
Z (zero epbi)	14 474	6 278	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
F (full epbi)	86	103	185	159	1 440
Total *n*	15 934	2 666	1 986	927	1 980
***n* correct**	14 474	1 067	329	361	1 440
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.



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 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. ■

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.