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Senepol feedlot performance and meat tenderness

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Abstract

The feedlot performance and meat tenderness of F1 Senepol x Brahman steers and Brahman steers were compared to determine whether crossbreeding with Senepols improved the meat quality of the progeny from Brahman cows in northern Australia. The performance in the feedlot was similar for both genotypes with no significant difference in average daily gain over the 73-day feeding period. Meat tenderness was evaluated by shear force testing of striploin samples from each carcase and the F1 Senepols were found to be more tender as they had significantly (P=0.003) lower average shear force results than the Brahmans (3.43 vs 3.86 kg). MSA assessment graded the F1 Senepol carcases into lower boning groups than the Brahmans (averages of 6.3 and 8.3, respectively).

Executive summary

This project was conducted to compare the feedlot performance and meat tenderness of F1 Senepol x Brahman steers versus that of Brahman steers to determine whether crossbreeding with Senepols is a way of improving the meat quality of the progeny from Brahman cows in northern Australia. The driving force behind this was the need for northern cattle producers to be able to increase their marketing options and thus be less vulnerable to live export market fluctuations.

As a result of the perception that they have lower meat quality, Brahman cattle from northern Australia often suffer price discrimination when they are sent to Australian domestic markets. This has not really been a problem in the past as the main market for northern cattle producers has been live export into South East Asia where demand for Brahman cattle has been strong as the cooking methods used there mean that meat tenderness is not really an issue. However it would be advantageous for north Australian producers to be able to produce cattle that perform well in their local environment and are in demand in both the live export and Australian domestic markets so that they have more marketing options and are less vulnerable to live export market fluctuations.

While it is has been well documented that *Bos indicus x Bos taurus* crosses have more tender meat than high grade Brahmans (*Bos indicus*), past introductions of pure British *Bos taurus* bulls to parts of northern Australia have often been unsuccessful as these bulls were not able to cope with harsh tropical conditions eg. high tick burdens. It was thought that a tropically adapted *Bos taurus* breed such as the Senepol may be more suitable for crossbreeding with Brahman cows provided that the bulls could cope with the northern Australian environment, and their progeny performed as well as Brahmans and had more tender meat. The NT DPIF has been conducting a Senepol crossbreeding research program since 2008 to answer these questions. The early indications from this work are that the F1 Senepol x Brahman progeny perform as well as Brahmans under northern NT conditions. It was not known how their meat tenderness compared and this project was conducted to determine this.

25 F1 Senepol x Brahman and 25 Brahman steers were used in this study to compare feedlot performance and meat tenderness. These animals had been bred on NT DPIF research stations in the Katherine/VRD region from Brahman cows that had both Senepol and Brahman bulls mated to them. The steers had been managed together their whole lives. This included being transported to the Douglas Daly Research Farm (about 220 km south of Darwin NT) shortly after weaning and grazing improved pasture in the same paddock there for about one year. The steers were transported to the Smithfield feedlot (near Proston, Qld) in July 2013 and fed a commercial ration there for 73 days. They were then slaughtered at the Dinmore abattoir and MSA carcase assessment was conducted. Whole striploin samples were collected from each carcase and sent to the University of New England meat science laboratory where shear force tests were used to evaluate meat tenderness and other meat quality traits.

There was no significant difference between the genotypes in feedlot performance. While the F1 Senepols grew slightly more quickly during the first 54 days in the feedlot, the differences between the genotypes in average feedlot induction weight (the F1 Senepols were 3 kg heavier) and average weight at slaughter (the F1 Senepols were 4.7 kg heavier) were similar. Over the 74 day feeding period the average daily gain (ADG) in the feedlot was 1.84 kg/day for the F1 Senepols and 1.82 kg/day for the Brahmans. However it should be noted that this contains quite a bit of compensatory gain following the weight loss in transport, and that if the empty weight at DDRF was used as the starting point then the ADG in the feedlot was 1.43 kg/day for the F1 Senepols and 1.42 kg/day for the Brahmans.

MSA carcase assessment found that the F1 Senepol steers on average were graded two boning groups better than the Brahmans (the price received for carcases is determined by the boning group that they are graded into). The average boning group was 6.3 for the F1 Senepols and 8.3 for the Brahmans. Most of the difference in grading was due to the F1 Senepols on average having 50 mm lower hump height than the Brahmans (which adversely affects grading in the MSA system).

Shear force tests conducted by the UNE meat science lab were used to assess the tenderness of the meat and the striploin samples from the F1 Senepol steers were found to have significantly lower (P=0.003) average shear force values than the Brahmans (3.43 kg vs 3.86 kg).

It should be noted that, while the meat of the F1 Senepols was found to be more tender than the Brahmans, the meat from the Brahmans in this study was still quite tender; shear force values of below 4.0 kg are considered to be quite acceptable. The shear force values for the Brahmans in this study were quite low in comparison to values that have been found from other Brahmans (average shear force = 5.5 kg with a range of 2.53 to 16.88 [R Polkinghorne unpublished]). The relatively high tenderness results found for both genotypes in this study is likely to be due to the fact that they had grown well and were relatively young for their weight. The average estimated age at slaughter of the steers was 21.5 months and the average carcase weight was about 238 kg.

This meat quality study combined with previous NT DPIF research, which has found that F1 Senepols perform at least as well or better than Brahmans in a range of growth and fertility measures, indicates that crossbreeding with a tropically adapted *Bos taurus* breed such as the Senepol is a good way for north Australian cattle producers to produce more tender beef and increase their marketing options.

Table of Contents

1 Background

Most cattle in northern Australia have a high *Bos indicus (*usually Brahman) content as they are generally able to perform better in the harsh tropical environments than *Bos taurus* cattle[1]. However *Bos indicus* cattle are usually regarded as having less tender meat than *Bos taurus* and some studies have shown that there is an almost linear reduction in tenderness as the proportion of *Bos indicus* genes increase[2,3].

As a result of the perception that they have lower meat quality, Brahman cattle from northern Australia often suffer price discrimination when they are sent to Australian domestic markets. This has not really been a problem in the past as the main market for northern cattle producers has been live export into South East Asia, where demand for Brahman cattle has been strong and the cooking methods used mean that meat tenderness is not really an issue. However it would be advantageous for north Australian producers to be able to produce cattle that are in demand in both the live export and Australian domestic markets so that they have more marketing options and are less vulnerable to live export market fluctuations.

The obvious solution to increase marketing options for herds with a high Brahman content is to incorporate *Bos taurus* genes. However in the past when pure British breed *Bos taurus* bulls have been introduced to northern Australia they often struggled to survive, let alone sire many calves. It has been suggested that in these sorts of environments that the use of a tropically adapted *Bos taurus* breed could be an effective strategy for improving meat tenderness[4]. Using a tropically adapted *Bos taurus* breed allows more rapid introduction of *Bos taurus* genes and a higher *Bos taurus* content than if crossbred British *Bos taurus* x *Bos indicus* bulls are used.

The NT DPIF began a project in 2008 to determine whether crossbreeding with a tropically adapted *Bos taurus* breed was an efficient way of quickly increasing the marketing options for north Australian cattle herds with a high Brahman content and reducing their vulnerability to downturns in the live export market. While a number of tropically adapted *Bos taurus* breeds (eg. Tuli, Belmont Red, Senepol) could have been used in this work, the Senepol was chosen because of it was known to have good meat quality[5,6] and produces offspring that are mostly polled.

While the research evaluating the NT DPIF Senepol crossbreeding program is ongoing, part of the work was to compare the feedlot performance and meat quality of F1 Senepol x Brahman steers to Brahman steers to determine whether crossbreeding Senepol bulls with Brahman cows actually produces offspring with improved meat quality to Brahmans. This report presents the findings of this aspect of the work.

While Senepols have a reputation for good meat quality and studies have found that they have similar meat quality to British *Bos taurus* breeds[6], there have not been any previous peer reviewed studies showing that Senepol x Brahman offspring have better meat quality than pure Brahmans. This needs to be established so that beef producers with Brahman herds in northern Australia can know whether crossbreeding with Senepols is an option to improve the meat quality of the cattle they produce.

2 Project objectives

The objectives of the project were: By 31 December 2014,

1. Compare the feedlot performance of Brahman and F1 Senepol x Brahman steers.

2. Compare the meat quality of Brahman and F1 Senepol x Brahman steers (via MSA assessment and via shearforce testing of samples of whole striploin aged for 5 and 14 days).

3. Store samples of striploin, aged for 5 and 14 days, for potential MSA sensory testing.

3 Methodology

Senepol bulls and Brahman bulls were mated to Brahman cows on NT DPIF research stations in the Katherine/VRD district to produce both Brahman and F1 Senepol x Brahman calves. Shortly after weaning the male calves were transported to the Douglas Daly Research Farm (DDRF) about 220 km south of Darwin, where they were processed (branded, castrated etc.) and then grazed improved Buffel pasture together in the same paddock for about 1 year.

In July 2013, 25 steers of each genotype were selected be used in the meat quality studies. To ensure that the steers selected for this work were not all sired by a few bulls, the paddock that they had been born in was taken into account during selection. Steers that had been born in several paddocks were selected so that that they would be representative of a number of sires and avoid the potential that the results could be strongly influenced by a small number of sires. It should also be noted that the average weight of both genotypes of steers was similar at this time as previously (in March 2013) those steers that had been approaching the 350 kg live export limit had been sold. 53% of the F1 Senepols were sold at this time compared to 16% of the Brahmans as more of the F1 Senepols were approaching the 350 kg limit. Therefore if all the potential animals had been available for use in this work it is likely that the average weight of the F1 Senepols would have been higher than the Brahmans.

On 11/7/13 the steers were weighed full (immediately after being mustered from the paddock) and then empty (after being held in the yards overnight with a 12 hour curfew of no feed or water) at DDRF before being trucked to the Cedar Park live export depot where they were held overnight (with access to hay) and inspected for ticks (they had previously been given injectable treatments for ticks on the 27/6/13 and 8/7/13) and given a clearing dip (which is required for interstate transport). They were then transported to the Smithfield feedlot (near Proston, Qld), with stops along the way for spelling at Brunette Downs and Longreach (the distance from Cedar Park to Proston is about 3,200 km). On arriving at the feedlot their induction weight was recorded on 18/7/13 and they were fed the Smithfield commercial ration (together in the same pen) for 73 days. The steers were all weighed on 10/9/13 to allow calculation of their average daily gain over the first 54 days in the feedlot. It was decided not to weigh them closer to the date of slaughter to avoid stress and possible bruising to the carcases.

The steers were slaughtered at the Dinmore abattoir on 30/9/13. The carcases were hung in a chiller overnight and full MSA carcase assessments were performed. The carcases were boned out on 1/10/13 and a whole striploin was collected from each carcase for meat quality assessment. The striploins were individually cryo-vacced with identifying labels placed inside the bags. The samples were then frozen overnight and transported in a refrigerated van to the University of New England (UNE) meat science laboratory where they were aged for 14 days before the standard meat quality tests were performed (ie. measurement of pH, lightness, redness, yellowness, cooking loss, and shear force). Samples were also prepared and frozen for potential future MSA sensory testing.

4 Results

The average weights for the two genotype groups on key dates at DDRF, the feedlot and the abattoir are shown in Table 1, as well as the weight gain or loss over periods of interest. The difference between genotypes is also shown.

Table 1. The average weights and weight gain or loss during periods of interest for Brahman and F1 Senepol steers (n=25 per genotype).

Measure	Brahman	F1 Senepol	Difference (F1 Sen. - Brah.)
Weight 11/7/13 - Full at DDRF (kg)	357.9	361.8	3.9
Weight 12/7/13 - Empty at DDRF (kg)	343.1	347.2	4.1
Weight 18/7/13 - Feedlot induction (kg)	314.0	317.0	3.0
Weight 10/09/2013 - Full after 54 days in feedlot (kg)	424.2	434.3	10.2
HSCW 30/9/13 - Carcase weight in abattoir (kg)	236.7	239.1	2.4
*Calculated weight at slaughter (kg)	446.6	451.3	4.7
Weight loss in transport to feedlot (kg) (Induction weight – full weight)	43.9	44.8	0.9
Weight loss in transport to feedlot (kg) (Induction weight – empty weight)	29.1	30.1	1.0
ADG over first 54 days in feedlot (kg/day)	2.040	2.172	0.132
Total weight gain in feedlot (using calculated weight at slaughter as the final weight) (kg)	132.6	134.3	1.7

*The calculated weight at slaughter was calculated from the average HSCW (Hot Standard Carcase Weight) assuming a dressing percentage of 53% for both genotypes.

While the F1 Senepols appeared to have a higher ADG over the first 54 days in the feedlot (2.172 vs 2.040 kg/day), statistical analysis found that this difference was not significant (p=0.148). None of the other differences were significantly different.

The averages of the different carcase measures reported in the abattoir kill sheets for the 2 genotypes (and the difference between them) are shown in Table 2.

Table 2. The average abattoir measurements for Brahman and F1 Senepol steers (n=25 per genotype).

Measure	Brahman	F1 Senepol	Difference (F1 Sen. – Brah.)
HSCW (kg)	236.7	239.1	2.4
Hump height (mm)	137.6	87.6	-50.0
Rib Fat (mm)	9.5	8.6	-0.9
Boning Group	8.3	6.3	-1.9
Eye Muscle Area (cm^2)	64.8	68.4	3.6
Ossification (Oss)	128.4	130.8	2.4
pH	5.46	5.44	-0.02
MSA Index	54.8	57.7	2.9
Price/Kg received	$3.55	$3.57*	$0.02
Body value (ex GST)	$846.62	$860.10*	$13.48

*Note- One F1 Senepol steer was ungraded as it was considered to be a dark cutter when its meat colour was assessed, and one F1 Senepol steer's rib fat measurement was considered to be too low and therefore received a price penalty. Their data has been excluded from the two measures marked with an asterisk in Table 2 as they were not considered to be representative. The one dark cutter may have been stressed during transport or handling prior to slaughter (the MSA assessors were surprised by the low number of dark cutters in these animals). The steer that was penalised due to its low rib fat is unlikely to have been selected if the F1 Senepol steers that were approaching 350 kg in March had not been sold and more of the heavier animals had been available to select from. The values for these two animals were $2.85 and $2.90 for price/kg received and $644.10 and $709.05 for Body Value (ex GST).

The number of steers of each genotype that were graded into each boning group is shown in Table 3. A higher proportion of the F1 Senepols were graded into the lower boning groups and the average boning group was 6.3 for the F1 Senepols and 8.3 for the Brahmans.

Table 3. The number of steers of each genotype graded into each boning group by MSA grading.

Boning group	Brahman	F1 Senepol
4		1
5		3
6		11
7	4	6
8	11	2
9	9	1
10	1	
*Ungraded		1
Total	25	25

*One F1 Senepol steer was ungraded due to meat colour ie. it was a dark cutter.

Table 4 shows the average price per kg received for carcases in each boning group. Price/kg received tended to increase as boning group decreased but was about the same for boning groups 5 – 8.

Table 4. The average price per kg received for carcases in each boning group.

Boning group	Average Price /kg received
4	$3.60
5	$3.57
6	$3.58
7	$3.57
8	$3.58
9	$3.51
10	$3.40

The results for the meat quality tests done by the UNE meat science laboratory are shown in Table 5.

Table 5. The average results for the meat quality tests (and the difference between genotypes) for Brahman and F1 Senepol steers (n=25 per genotype).

	Brahman	F1 Senepol	Difference (F1 Sen. – Brah.)
Shear force (kg)	3.86	3.43	-0.44
Ultimate pH	5.46	5.49	0.03
L-value (lightness)	41.47	39.53	-1.94
a-value (redness)	19.86	20.41	0.55
b-value (yellowness)	8.91	9.19	0.28
Cooking loss (%)	25.51	25.06	-0.46

There were significant differences between the genotypes for pH ($P = 0.002$), L-value ($P < 0.001$), and shear force ($P = 0.003$) using one way ANOVA tests. None of the other differences between genotypes for the meat quality tests were statistically significant.

Samples have been stored at the UNE meat science laboratory for possible future MSA sensory testing.

5 Discussion / conclusion

The data in Table 1 shows that the two genotypes had similar average weights throughout the study period. The F1 Senepols started out about 4 kg heavier at DDRF and the difference between the genotypes appears to have remained about the same throughout the study if the average calculated weight at slaughter is used as the final weight. The difference between the genotypes appeared to increase to 10.2 kg in favour of the F1 Senepols after 54 days in the feedlot but then reduce back to 4.7 kg by slaughter. The reasons for this can only be speculated. Perhaps the F1 Senepols were quicker to adjust to the feedlot diet than the Brahmans and then the Brahmans caught up, or they may have had greater gut fill at the time of weighing. Regardless, the difference in ADG between the genotypes over the first 54 days in the feedlot was not significant, and overall it can be concluded that there was no difference between genotypes in their feedlot performance.

It should be noted that while the average weight of the steers used in this study was similar for both genotypes at DDRF in July 2013, that this would not have been the case if those animals approaching the live export limit of 350 kg had not been sold in March 2013. A greater proportion of the F1 Senepol steers were sold at this time as more of them were heavier (53% of F1 Senepols and 12% of Brahmans were sold). The average weight of all the 2012 weaned steers for both genotypes on 19/3/13 was 283 kg for the Brahmans and 320 kg for the Senepols and so if those approaching the live export limit had not been sold, it is likely that when the steers were selected for the feedlotting and meat tenderness studies that the average weight of the F1 Senepols would have been higher.

Both genotypes lost about 12% of their full liveweight (paddock weight) or 9% of their empty (fasted overnight) liveweight during the transport from DDRF to the feedlot. There would have been some compensatory growth in the feedlot following this weight loss, and this would have contributed to the high ADGs (>2 kg/day) during the first 54 days of feedlotting.

Using the average calculated weight at slaughter as the final weight at the end of the feedlotting period, the average daily gain (ADG) in the feedlot over the whole feeding period was 1.84 kg/day for the F1 Senepols and 1.82 kg/day for the Brahmans. These ADGs are not statistically different and are lower than those calculated over the first 54 days of feeding, as the compensatory gain after the weight loss in transport would have had a greater effect on ADG in the shorter period (ie. the first 54 days). It should be noted that the ADG figures for the whole feeding period still contain quite a bit of compensatory gain following the weight loss in transport, and that if the empty weight at DDRF was used as the starting point then the ADG in the feedlot was 1.43 kg/day for the F1 Senepols and 1.42 kg/day for the Brahmans.

Abattoirs in Australia use the MSA grading system to determine which carcases they will pay MSA prices for. At Dinmore (a JBS abattoir) they pay MSA prices for boning group 9 and lower. All the steers in this study were graded into boning group 9 or lower except for one Brahman steer which was graded into boning group 10. However Table 3 shows that more F1 Senepol steers were graded into the lower boning groups and the average boning group was 6.3 for the F1 Senepols and 8.3 for the Brahmans. This means that there is “more margin for error” for the F1 Senepols so that if all the steers had not grown so well (eg. were fed for a shorter time in the feedlot, had a worse season while grazing pasture, grazed native pasture instead of improved pasture post weaning etc.) then most of the F1 Senepols would still be graded below boning group 10 while many of the Brahmans would not.

Much of the reason that the F1 Senepols were graded better than the Brahmans was due to hump height which was on average 50 mm lower in F1 Senepols than Brahmans. Under the MSA grading system high hump heights are penalised due to associations with poor eating quality. It is evident from this study that crossbreeding Brahman cows with Senepol bulls reduces the hump height of the progeny and under the current MSA grading system this is advantageous.

Other than hump height most of the other abattoir kill sheet measures were similar for the two genotypes (Table 2). There were slight differences in rib fat which was on average 0.9 mm less in the F1 Senepols and eye muscle area which was on average 3.6 cm^2 more in the F1 Senepols. The MSA assessors commented on how well the Brahmans graded and both they and the feedlot supervisor were impressed with how both genotypes performed.

Despite the fact that the F1 Senepols were on average graded into lower boning groups the difference in price/kg received was not as great as would be expected (ie. it was only $0.02/kg more for F1 Senepols). This is because very similar prices were paid for carcases in boning groups 5-8 and most carcases were in these boning groups (see Table 4). Also the abattoir has its own price grid that uses both grading data and carcase weight to determine the price paid for each carcase. Due to the way this grid works, carcases within the same grading group can receive different prices if they are different weights. Also a heavier carcase in one grading group may be paid the same price/kg as a lighter carcase in lower grading group.

The meat quality testing found that there were significant differences between genotypes for pH ($P = 0.002$), L-value (lightness) ($P < 0.001$), and shear force ($P = 0.003$), while none of the differences between the other meat quality tests were statistically significant. The result of most interest from the meat quality testing was the difference in shear force with the F1 Senepol samples being on average 0.44 kg more tender.

It should be noted that while the meat of the F1 Senepols was found to be more tender than the Brahmans, that the meat from the Brahmans in this study was actually found to be quite tender. Shear force values of below 4.0 kg are considered to be tender (Geert Geesink *pers. comm*). The shear force values for the Brahman steers in this study were quite low in comparison to values that have been found from other Brahmans (evaluation of data from 1,298 Brahman striploin samples found that the average shear force was 5.5 kg with a range of 2.53 to 16.88 kg - Rod Polkinghorne *unpublished*.). The good tenderness results found for both genotypes in this study is likely to be due to the fact that they had grown well and were relatively young for their weight at slaughter (the average estimated age at slaughter of the steers was 21.5 months and the average carcase weight was about 238 kg).

This meat quality study combined with previous research which has found that the F1 Senepols perform at least as well or better than Brahmans in every growth and fertility measure studied so far by the NT DPIF, suggests that crossbreeding with a tropically adapted *Bos taurus* breed such as the Senepol may be a good way for north Australian cattle producers to produce more tender beef and increase their marketing options.

It should be noted by people considering starting a Senepol crossbreeding program in northern Australia that although Senepols have quite good tick resistance, they are as susceptible to tick fever as British *Bos taurus* breeds. Therefore it is worthwhile ensuring that Senepol bulls have been vaccinated for tick fever if they are going to be transported to locations where ticks are a problem. Tick fever is unlikely to be a problem in their progeny if Senepol bulls are used in a crossbreeding program with Brahman cows, as the progeny will have better resistance due to their higher Brahman content, and also calves can acquire resistance to tick fever if they are bitten by ticks while suckling from cows that have resistance.

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