Proc. Assoc. Advmt. Anim. Breed. Genet. 22:473-476

BREED VARIATION IN TONGUE COLOUR OF DAIRY AND BEEF-CROSS-DAIRY CALVES

L.W. Coleman, H.T. Blair, N. Lopez-Villalobos, P.J. Back, R.E. Hickson

Institute of Animal, Veterinary and Biomedical Sciences, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand.

SUMMARY

Both Angus-cross and Holstein-Friesian-cross-Jersey cattle may have a completely black coat colour, making it difficult to identify breed of newborn calves when Angus bulls are used in New Zealand dairy herds. Holstein-Friesian cattle possess a white spotting gene causing non-pigmentation in coat colour and a pink coloured tongue, whereas Angus cattle have black tongues. The objective of this experiment was to identify whether tongue colour could be a useful predictor of breed in Angus-cross-dairy and dairy-breed calves. Tongue colour of 476 calves soon after birth was classified as being pink, black or pink and black spotted. The conditional probability of a calf with a black tongue being Angus-cross was 0.95 and dairy breed 0.05. The conditional probability of a calf with a pink tongue being dairy breed was 0.85 and Angus-cross 0.15. Culling calves solely on having a black coloured tongue would correctly cull 73% of Angus-cross calves, and retain 90% of dairy-breed calves. Culling calves on possessing a black or pink and black tongue would correctly cull 96% of Angus-cross calves, but also cull 38% of dairy-breed calves. Breed identification on tongue colour alone is insufficient to correctly identify the breed of calves from a New Zealand dairy herd.

INTRODUCTION

If a dairy farmer uses a beef bull to increase value of surplus calves, it can be difficult for the farmer to identify the breed of calves born, so as to retain only dairy-breed calves as replacements. Of beef bulls used in the New Zealand dairy herd, the main breed is Hereford (DairyNZ 2016), in part because the resulting calf will have a white face, making the beef-cross calf easy to identify. When an Angus bull is used, the resulting calves are usually completely black, and they look similar to Holstein-Friesian-cross-Jersey and some Holstein-Friesian calves. Other phenotypic factors might be useful to identify these calves.

The New Zealand dairy herd is comprised predominantly of Holstein-Friesian (33.5%), Jersey (10.1%) and Holstein-Friesian-Jersey crossbreed (47.2%) (DairyNZ 2016). In New Zealand, dairy cows, a straight-bred cow is defined as having ≥14/16 of any one breed's genetics (DairyNZ 2016). Therefore, a cow classified as Holstein-Friesian may have up to 2/16 Jersey genetics.

Previous authors have reported using colour of coat markings, ears and noses in cattle and sheep to identify different genotypes (Pitt 1920, Dry 1924, Ibsen 1933, Dry 1936, Bogart & Ibsen 1937). Coat and tongue colour of straight-bred cattle have been previously investigated (Ibsen 1933). Straight-bred Angus cattle have a completely black coat, with black skin and a black tongue (Ibsen 1933). Straight-bred Holstein-Friesian cattle have a black coat with white patches on the body, white legs below the knee and a pink tongue (Ibsen 1933). Ibsen (1933) proposed that the pink tongue was a result of the animal being homozygous for a recessive white-spotting gene. Straight-bred Jersey cattle are a diluted shade of red with blackened hairs, and black pigmentation on the skin, nose and tongue. The black pigmentation is the result of a dominant black spotting gene (Ibsen 1933). In the same paper, Ibsen proposed that some Jersey cattle also carry the Holstein-Friesian white-spotting gene. Based on Ibsen's theories, an Angus-cross-Holstein-Friesian or Angus-cross-Jersey animal would be expected to be completely black with a black tongue, and black pigmentation on the skin. A Holstein-Friesian-Jersey-cross animal could have a

coat colour ranging from the Holstein-Friesian type black with white patches, to a black coated animal with little to no white patches. The tongue colour of a Holstein-Friesian-Jersey-cross would be expected to be pink, pink with black spotting or completely black due to the black spotting gene. The objective of this study was to identify whether tongue colour could be used to identify the breed of calves born from a dairy herd mated to both Angus and dairy bulls, for the purpose of keeping the dairy calves, and culling the calves sired by an Angus bull.

MATERIALS AND METHODS

The experiment was conducted at Limestone Downs dairy farm in Port Waikato New Zealand, with approval from the Massey University Ethics Committee.

Four hundred and seventy-five calves born on the farm during the calving period in 2016 were used in this experiment. Calves were born to cows in a predominantly Holstein-Friesian and Holstein-Friesian-cross-Jersey herd, and sired by an Angus, Jersey or a Holstein-Friesian bull. Calves were identified to dams by the farmer at the time of calf removal, within 24 hours of birth. Calves were identified as being an Angus-cross (n=347), Jersey-cross (n=80), or Holstein-Friesian-cross (n=48) by visual assessment of the animal and through mating records for the probable dam. Visual assessment of the animal consisted of looking at coat colour, physical shape and checking if the calf was polled. The calves suspected of being Angus or Jersey-cross were sampled for DNA parentage analysis (Zoetis, Dunedin, New Zealand). Breed was DNA verified for the Angus-cross and Jersey-cross calves by assigning parentage to a bull of the respective breed.

Tongue colour was recorded at the time of visual assessment. Colour was assessed by opening the mouth of the calf and looking at the top of the tongue. Colour was recorded as being either completely pink, completely black or having a combination of black and pink patches (spotted). No attempt was made to quantify the proportion of pink and black for calves with spotted tongues.

The probability of a calf being a particular breed based on the colour of its tongue was calculated using conditional probability. For example, the probability of a calf being Angus-sired given it had a black tongue was calculated using the equation for conditional probability:

$$P(Angus|black\ tongue) = \frac{P(Angus \cap black\ tongue)}{P(black\ tongue)}$$

where $P(Angus \cap black\ tongue) = \frac{number\ of\ Angus\ calves\ with\ black\ tongue}{total\ number\ of\ calves}$

and $P(black\ tongue) = \frac{number\ of\ calves\ with\ black\ tongue}{total\ number\ of\ calves}$.

RESULTS

Seventy-three percent of Angus-cross calves possessed a black coloured tongue, while only 10% of dairy calves had a black tongue. Holstein-Friesian-cross calves had a lower occurrence of black tongues than Jersey-cross calves (6% and 13% respectively, Table 1). A calf with a black tongue was highly likely (95%) to be Angus and only 1% or 4% likely to be Holstein-Friesian- or Jersey-cross respectively (Table 1).

Table 1: Proportion (%) of calves within each sire breed with each tongue colour, and the conditional probability of a calf possessing a specific coloured tongue being each breed. Dairy breed comprised of Jersey and Holstein-Friesian sired calves (individual breeds in italics)

Sire Breed	n	Black Tongue (B)		Spotted tongue (S)		Pink Tongue (P)	
		Proportion of breed	P (breed | B tongue)	Proportion of breed	P (breed | S tongue)	Proportion of breed	P (breed | P tongue)
Angus	347	73	0.95	23	0.70	4	0.15
Dairy	128	10	0.05	27	0.30	63	0.85
Jersey	*80*	*13*	*0.04*	*34*	*0.23*	*54*	*0.46*
Holstein-Friesian	*48*	*6*	*0.01*	*17*	*0.07*	*77*	*0.39*

A pink coloured tongue was the most common colour for dairy calves (63%) with Holstein-Friesian-cross calves having a 77% incidence and Jersey-cross having a 54% incidence of pink tongues (Table 1). Pink was the least common tongue colour in Angus-cross calves (4%, Table 1). A calf with a pink tongue was most likely to be Holstein-Friesian- (39%) or Jersey-cross (46%), but still had a 0.15 probability of being Angus-cross (Table 1).

A spotted tongue was more common in Jersey-cross (34%) and Angus-cross (23%) calves than Holstein-Friesian-cross (17%) calves (Table 1). Calves with tongues showing pink and black spotting had a greater probability of being an Angus-cross (0.7) than a dairy-cross (0.3) breed (Table 1). The calves with a spotted tongue had a greater probability of being a Jersey-cross (0.23) than a Holstein-Friesian-cross (0.07) calf (Table 1).

The number of calves with spotted tongues from all three breeds raises a question of whether spotted tongue calves should be culled or kept when imposing tongue colour as a culling criterion. If Holstein-Friesian-cross and Angus-cross calves were to be identified solely on tongue colour, and any calf with a black tongue was culled, this experiment indicates that 94% of Holstein-Friesian-cross calves would be correctly retained, however, 27% of Angus-cross calves would also be retained as replacement dairy calves (Table 2). If tongue colour were to be used to identify calves as dairy (Holstein-Friesian- and Jersey-cross) or Angus-cross, culling all calves with a black tongue would unnecessarily cull 10% of dairy breed calves (Table 2).

If calves were to be culled if they had a black, or a spotted tongue, this study suggests 96% of Angus-cross calves would be correctly identified, along with 23% of Holstein-Friesian-cross calves unnecessarily culled (Table 2). When identifying calves as Angus-cross or dairy, the percentage of dairy breed calves unnecessarily culled would be 38% (Table 2).

Table 2: Comparison of the chance of keeping or culling a calf on tongue colour given the sire-breed. Sensitivity is the proportion of correctly kept Holstein-Friesian or dairy (Holstein-Friesian and Jersey) calves. Specificity is the proportion of correctly culled Angus calves

	Culling on black tongue only		Culling on black or spotted tongue	
	Holstein-Friesian	Angus	Holstein-Friesian	Angus
Keep	0.94	0.27	0.77	0.04
Cull	0.06	0.73	0.23	0.96
	Dairy Breed	Angus	Dairy Breed	Angus
Keep	0.90	0.27	0.63	0.04
Cull	0.10	0.73	0.38	0.96

DISCUSSION AND CONCLUSION

Angus-cross calves are more likely to have black tongues and less likely to have pink tongues than dairy calves, however, the high incidence of calves in all breeds with a spotted tongue means that either keeping or culling those with a spotted tongue resulted in a large proportion of falsely identified calves.

The cows in the dairy herd used to produce the calves varied in proportion of Holstein-Friesian and Jersey genetics. There are a small number of cows in the herd which have breeds other than Holstein-Friesian and Jersey in their pedigree, and not all cows have a fully recorded pedigree. Consequently, the full pedigree of each calf cannot be identified, and it is likely that differing proportions of Holstein-Friesian and Jersey genes contribute to the different tongue colours observed.

In reference to Ibsen (1933), there is clearly a relationship to Angus having a black colouring gene and possessing a black tongue. However, 23% of Angus calves had a spotted tongue, which may indicate that tongue colour is more affected by the white-spotting gene from the Holstein-Friesian genetics, than the coat colour is. There were 4% of Angus-cross calves possessing a pink tongue, which may be a result of extreme white-spotting, as the tongues were assessed *in vivo* it cannot be said with certainty that there were no black spots deep in the mouth.

There was one Angus bull used in the experiment, of which 5 of its 10 progeny had a pink tongue, therefore, it is likely that this bull was bred up, and carrying a recessive gene for white spotting. Ibsen (1933) hypothesised that the black-spotting gene causing black tongues in Jersey cattle is dominant over the Holstein-Friesian white-spotting. While this may be true of the 5 white points (four feet and forehead) typical of a Holstein-Friesian being black pigmented in the crossbreed, the theory does not hold up with pigmentation of the tongue. The results from this study suggest that inheritance of tongue colour is more complicated than suggested by Ibsen (1933).

The results of this study suggest that tongue colour may provide useful clues for breed identification because black tongue calves were highly likely to be Angus-cross and pink tongue likely to be dairy calves. It was not infallible however, and the occurrence of spotted tongues raised an issue of whether to keep or cull the calf, as spotted tongues were no more likely to be Angus-cross than dairy. Although it is not reliable as a sole indicator, tongue colour could be combined with other visual assessments to help inform cull/keep decisions.

ACKNOWLEDGEMENTS

This experiment was funded by Beef+Lamb NZ Genetics. The authors would like to thank Angus New Zealand and Limestone Downs farm for their contributions to the project, and also to Geoff Purchas and Joanna Gillingham for their assistance recording tongue colour.

REFERENCES

Bogart, R. & Ibsen, H. L. (1937) *Journal of Genetics.* **35**:31
Dairynz (2016) New Zealand Dairy Statistics 2015-16
https://www.dairynz.co.nz/media/5416078/nz-dairy-statistics-2015-16.pdf
Dry, F. W. (1924) *Journal of Genetics.* **14**:203
Dry, F. W. (1936) *Journal of Genetics.* **33**:123
Ibsen, H. L. (1993) *Genetics*.**18**:441
Pitt, F. (1920) *Genetics.* **9**:281