Contributed paper

THE BENEFIT OF A SLICK HAIR COAT FOR HEAT TOLERANCE IN NEW ZEALAND DAIRY CATTLE

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SUMMARY

The slick genetic variant is a single base deletion in the prolactin receptor of cattle which produces a short hair coat and improves heat tolerance. In 2014, a breeding programme begun in New Zealand to introgress this variant from the Senepol beef breed (*Bos taurus*) into a New Zealand dairy genetic background. Heat tolerance was assessed in lactating heifers (12.5% Senepol, 87.5% NZ crossbred) using maXtec rumen boluses for long-term data collection. In mid-lactation, when the daily THI was at ~70 in late afternoon, rumen temperatures were similar between a group of slick heifers (N=9) and an age and size matched control group (N=9). The differential of rumen temperature, associated with the slick variant, became increasingly evident as the THI increased above ~70, with the maximum temperature difference ranging between 0.5-1.0°C at a THI of ~75. Accumulated milk volume in the slick heifers was ~82% of that in a contemporary group of heifers, reflecting the lower genetic merit of the slick group.

INTRODUCTION

The slick gene is a term used to describe a major, dominant gene segregating in Senepol and other Criollo beef and dual-purpose breeds, in association with a short, slick hair coat (Olson *et al*. 2003). The causal mutation was identified as a deletion in the final exon of PRLR on BTA 20, leading to a truncation of the protein (Littlejohn *et al*. 2014). Similar mutations leading to various degrees of truncation in PRLR have been identified in several other breeds showing the same slick hair coat (Porto-Neto *et al*. 2018). The advantages of the slick hair coat in cattle are improved heat tolerance (Olson *et al*, 2003; Dikmen *et al*, 2014) and tick resistance (Ibelli *et al*. 2014). Data on heat tolerance of slick dairy cattle is limited. With climate change, the potential utility of the slick variant is obvious, particularly in dairy cattle with high feed intake and therefore elevated heat production. In addition, grazing systems in New Zealand (NZ) add to the heat load through solar radiation, mitigated, in part by cooling winds.

A breeding programme to introgress the slick variant into a dairy genetic background was begun in 2014 by crossing NZ dairy cattle with Senepol sires. The subsequent focus has been on maximising the genetic merit for dairy and reducing the proportion of beef genetics in slick offspring while conducting several trials to understand the benefits of the slick coat.

MATERIALS AND METHODS

The heifers used were born in spring 2018 and entered their first lactation in spring 2020. Slick genotype was confirmed from ear punches by PCR, as described by Littlejohn *et al*. (2014). The trial was performed on a commercial milking herd at LIC's Innovation farm at Rukuhia, Waikato. The herd was milked twice daily, walking from paddock to the milking shed (~600 metres) at 5.30 AM and 2 PM. All milking cows were managed in the same herd, where the diet was predominantly pasture based with a supplement of maize silage, turnips and grass silage. Weather measurements, ambient temperature, relative humidity and rainfall, were collected hourly from the National Climate Database (Ruakura AgResearch/NIWA weather station, Hamilton, New Zealand). All the experiments reported were approved by the Ruakura Animal Ethics Committee.

Nine heterozygous slick heifers (12.5% Senepol 87.5% NZ Holstein Friesian, Jersey crossbred) calved in August 2020 and joined the commercial milking herd. The slick heifers were sired by 3 different slick carrier sires while a matched (age and size) control group of 9 heifers represented 6 different Friesian-Jersey crossbred sires. All 18 heifers received smaXtec rumen temperature boluses in mid lactation (SmaXtec Classic BolusTX-1442A, SmaXtec animal care GmbH Belgiergasse 3, 8020 Graz, Austria). Rumen temperature data was compared to vaginal temperatures for 2 7-day periods using intra-vaginal data loggers (DST centi-T, accuracy: ±0.1°C, resolution: ±0.032°C; Star-Oddi, Gardabaer, Iceland) attached to a shortened, hormone-free controlled internal drug release (CIDR) insert as described by Tresoldi et al. 2020. Data presented were collected in January 2021 when the animals were in mid-lactation (~140 days in milk). Rumen temperature data was corrected for effects of drinking using the smaXtec proprietary algorithm.

RESULTS AND DISCUSSION

Rumen temperature was ~39ºC in the morning before milking but rose from mid-morning to achieve a small differential between the slick and control groups of ~0.2°C when the Temperature-Humidity Index (THI) was 70 (Figures 1 and 3).

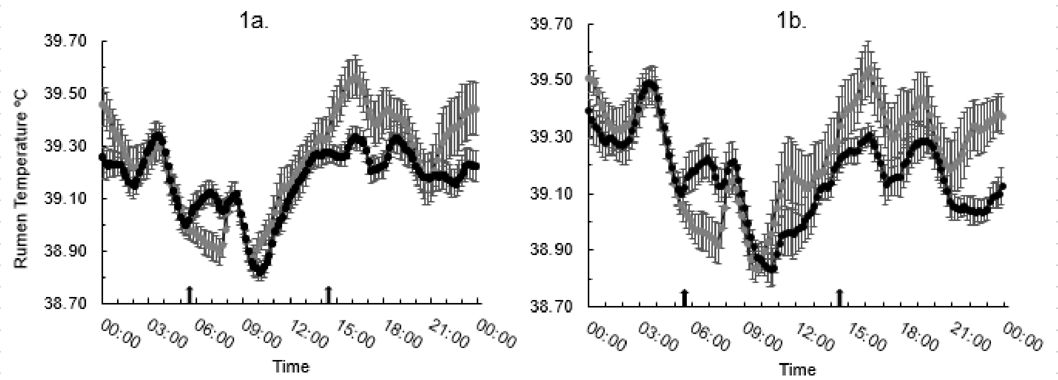
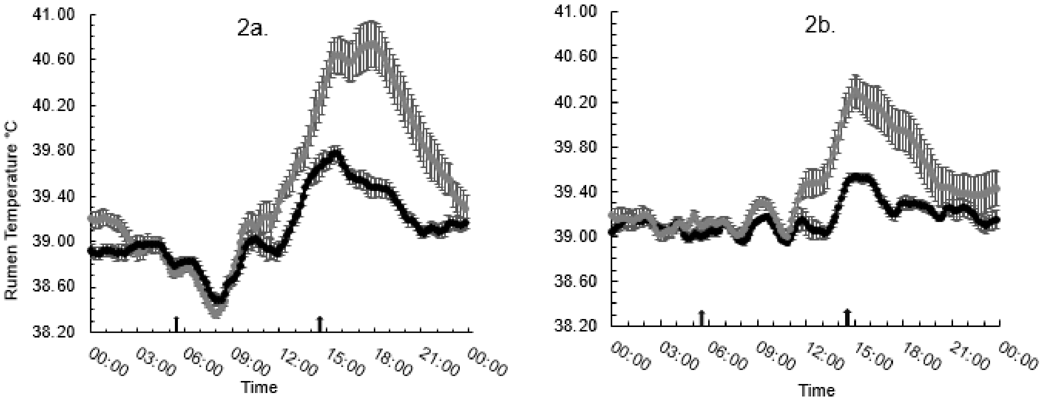


Figure 1. Mean rumen temperatures over 2 cooler days for slick (black) and control (grey) heifer groups, where the THI and ambient temperature at 4 PM was: 1a. 70 THI and 23.3°C, 1b. 69 THI and 24°C. Arrows indicate milking times.

When late afternoon THI was 74-76, rumen temperatures were similar among control and slick groups until late morning (Figure 2). Differences in rumen temperatures between groups were significant ($P<0.001$ by t-test) by early afternoon and rose to a peak difference of 0.8-1°C between 3 and 6 PM on both days presented. Part of the temperature rise was associated with the afternoon milking and the heat increment associated with the walk to the milking shed (~600 metres). On both days, the temperatures in the slick animals returned to a baseline more rapidly than the controls. Additionally, the rumen temperature was markedly less variable among the slick animals compared to the controls, particularly during peak rumen temperatures in late afternoon.



The difference in average peak (3.30-5.30 PM) rumen temperature between the slick and control groups was related to THI, increasing from 0.2°C at a THI of < 71 to 0.5-1.0°C at a THI of 74-76 (Figure 3). Different authors have provided different THI threshold values at which heat stress begins, ranging from 68-74 units (Herbut *et al*. 2018). The highest increment in rumen temperature, at THI of 74, observed in this study was from 39-40.6ºC in control animals, where the slick group increased from 39-39.6ºC (Figure 2a). Rumen and vaginal temperatures were also measured in the same heifers, showing that temperatures measured in the vagina were lower than the rumen by 0.8-1.0°C (data not shown). The vaginal temperature differential between slick and control groups was equivalent to that seen in the rumen. Dikmen *et al*. 2014 found similar results and reported a 0.5°C difference in the afternoon in vaginal temperatures in genotyped slick, Holstein cattle in Florida. Comparable data were reported for vaginal temperatures in slick Holstein cattle in Puerto Rica (Sánchez-Rodríguez 2019), although slick animals were not confirmed to genotype.

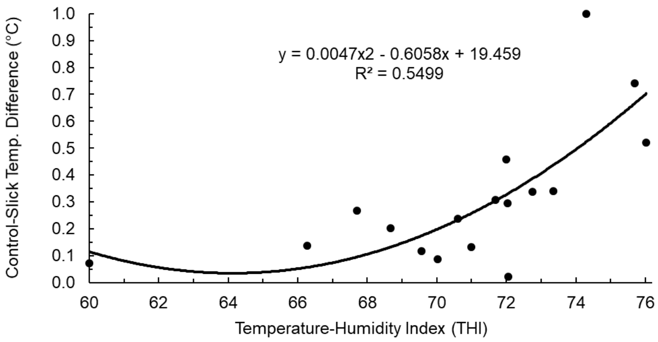


Figure 3. Difference in mean rumen temperature (mean 3.30-5.30 PM) between control and slick heifers on 16 days in January 2020 as related to THI at 4 PM

The mechanism by which the slick coat enables maintenance of a lower temperature in the face of higher heat loads remains to be established. Dikmen *et al*. (2014) suggested an association with increased sweating rate and an enhanced ability to dissipate heat at higher environmental temperatures appears to be involved. To measure the full potential of the slick hair coat in NZ, more research is required to develop a customized heat load index. The high heat load through solar radiation in New Zealand, as well as the effect of cooling winds, is currently not considered in the THI.

Milking performance of the slick cows was 18% lower than their non-slick contemporaries, commensurate with their lower overall genetic merit measured as gBW (Table 1).

Table 1. Comparison of average milk production and genetic merit merit (assessed as genomic breeding worth, gBW) between the slick group (N=9) and a cohort of contemporary milking heifers (N=58) for the 2020/21 season based on monthly herd testing

Group	Days in milk	Average accumulated milk yield (l)	Average accumulated fat yield (kg)	Average accumulated protein yield (kg)	gBW* ($)
Slick (N=9)	257	3350	176	139	118
Contemporaries (N=58)	272	4080	215	163	213

CONCLUSIONS

Even at a relatively low THI (~75) slick heifers at grazing had a substantially lower rumen temperature (0.5-1.0°C) than their non-slick counterparts. The differentials in rumen temperatures between the heifer groups was similar to that observed in vaginal temperatures. The slick genotype has the potential to confer substantial benefit to heat tolerance in dairy cattle, but more research is needed to understand the production and welfare value that the slick genotype brings.

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