College of Tropical Agriculture
and Human Resources
University of Hawai'i at Mānoa

Livestock Management
December 2015
LM-30

Hair Coat Color Influenced the Longevity of Holsteins in the Sub-Tropics

K.S. Baek[1] and C.N. Lee[2]
[1]National Institute of Animal Sci., RDA, Chungnam, S. Korea. [2]Dept. of Human Nutrition, Food and Animal Sciences, College of Tropical Agriculture and Human Resources (CTAHR), University of Hawai'i-Manoa
Contact: C.N. Lee, chinl@hawaii.edu

Abstract

More than a decade of observations of dairy operations in Hawai'i suggested that there were more black cows in the local dairy herds than white cows. Hence, the objective of the study was to investigate if hair coat color affected productive life of Holstein cows in the sub-tropics. Two large herds within 2,000 meters of each other in the Waianae Coast district were used. Lactating cows were classified into the following groups: 1) white (W, >90 percent of the body hair coat was white); 2) black**:**white (BW, the percentages of black and white hair coat on the cows were close to 50:50), and 3) black (B, >90 percent of the body hair coat was black). In Farm A, 211 out of 970 lactating cows were identified for study. In Farm B, 690 of the 1,350 lactating cows met the above criteria. Regression analyses with hair coat color on the y-axis and number of lactations in the respective herd on the x-axis suggest that the proportion of B cows increased in both farms with increasing lactation numbers while the proportion of W cows decreased. There was no change in the proportion of BW cows within a herd. Hair coat characteristics and milk yield are discussed in this paper.

Keywords: hair coat color, Holsteins, longevity, lactation numbers.

Figure 1. The majority of cows in a Holstein herd are black.

Introduction

Raising high-production dairy cows in the tropics can be challenging given the high temperatures, intense solar radiation, and high humidity. The major contributors to this challenge are feed intake and subsequent heat production in the lactating cow. Hence productivity of dairy cattle in the tropics and sub-tropics is affected by their longevity in a herd as well as herd yield.

While the desired target is to have a heifer begin lactation by age 24 months, many dairy operations do not meet this target (Stevenson 2010). The North Carolina DHI records showed that in many operations animals begin their lactation at age 25 to 27 months (average 25.7 months for Holsteins). A study in Virginia (Cassell 2004) showed an even higher age at first calving—27.6 months. Hence, the cost of raising these animals is best recovered by higher milk production and longevity in production within a herd or lifetime production of the animals.

Observations in dairy herds in Hawai'i suggest that operations have more cows that are black versus white. Hence, a retroactive study was performed using the dairy milk records from the two largest commercial herds in the state. These two herds are within 2000 meters of each other but have different environmental modifiers,

such as the use of fans and/or misters in their respective operations. Both dairies are open dry-lot operations.

Objectives

The objectives of the study were to a) determine whether there are more black cows in the herd due to longevity, b) determine the level of production of the cows based on hair coat color, and c) make an initial attempt to explain the relationship between the hair coat and productivity within a herd in the sub-tropics. The study was conducted in 1999 and has laid the foundation for several other studies on hair coat in cattle under heat-stress conditions.

Materials and Methods

The study used the Dairy-comp 305 database, which was employed by the two herds for milk production records. Herd A had 970 lactating Holstein cows and herd B had 1,350 lactating Holstein cows. Historically, herd A had always had higher milk production due to better management.

The color of the animals was determined by the authors. Cows were classified into 3 groups: >90% black, >90% white, and 50:50 black:white hair coat colors. Cows with hair coat coloration outside of these parameters were not included in the study. This reduced the ambiguity in terms of the proportion of black or white hair coat color. If there was a disagreement as to the color, the animal is either excluded or a third party (farm owner or manager) was asked to provide his or her opinion.

Two hundred and eleven cows that had had 4 or more lactations were identified in herd A. Six hundred and ninety cows that had had 2 more lactations were identified in herd B. There would not have been a sufficient number of cows for analysis in this herd had the same criteria of 4 or more lactations been employed for herd B.

Hair was shaved from the thurl and shoulder area of the cow using a shaving blade. The shaved area was measured in centimeters. The removed hair was then placed in a small Ziploc bag and weighed in the laboratory.

Statistical Analyses

A 3-way ANOVA analysis of variance for milk production (kg./305-day lactation) based on hair coat color was performed for both herds. In addition, regression analyses on hair coat color (y-axis) and lactation numbers (x-axis) were performed for each color group within a herd. Lastly, samples of hair by color were weighed as an indirect measure of the thickness of each hair. No attempt was made to compare the data between herds as there are different environmental modifiers and nutrition and management factors involved.

Results and Discussion

Figure 2 shows the breakdown (percentages) of the cow population for the study by hair coat color within each herd. Black cows were dominant in both herds. The black cow population for farm A was 59.7%, while it was 49.4% for farm B. The black:white (50:50) population comprised

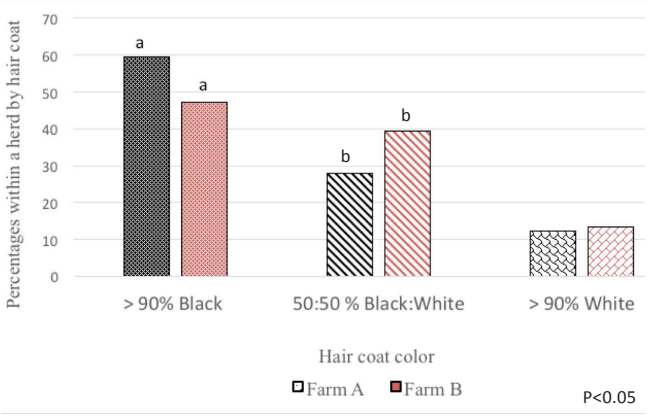


Figure 2. Distribution by hair coat color for animals per respective farm. Different superscripts within a farm denote differences in cow population based on hair coat color. n= 211 cows and 690 cows per farm respectively.

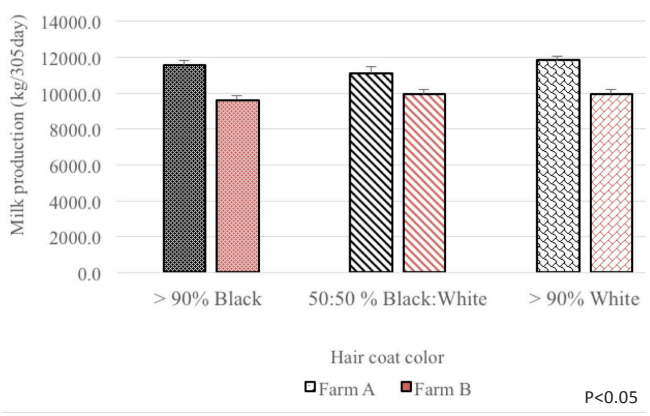


Figure 3. Milk production (kg/305 days) for each hair coat color per respective farm. Milk production (mean ± SE) was not statistically different for different hair coat color within a farm.

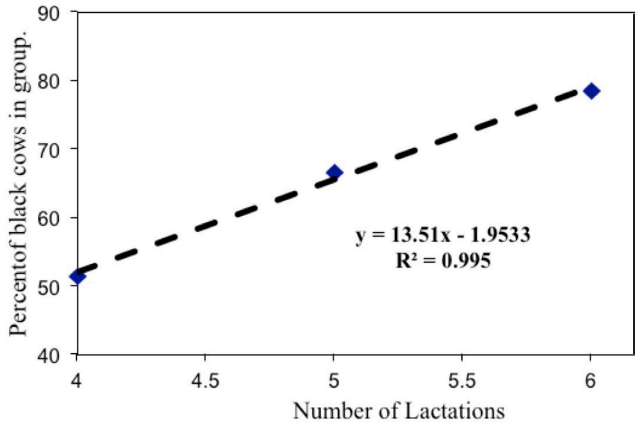
28.0% and 39.3% for farm A and B respectively. The cow population with >90% white hair coat was very similar between the 2 farms: 12.3% and 13.3% respectively.

Figure 3 shows the milk production by hair coat color within each herd. Cows with white hair coat (>90%) had higher milk production, but not to a statistically significant extent. In farm A, white cows had 295 kg. and 709 kg. higher milk production per 305 days compared to black and black:white (50:50) cows, respectively. In farm B, white cows had 317.3 kg. and 8 kg. higher milk production per 305 days compared to black and black:white (50:50) hair coat animals.

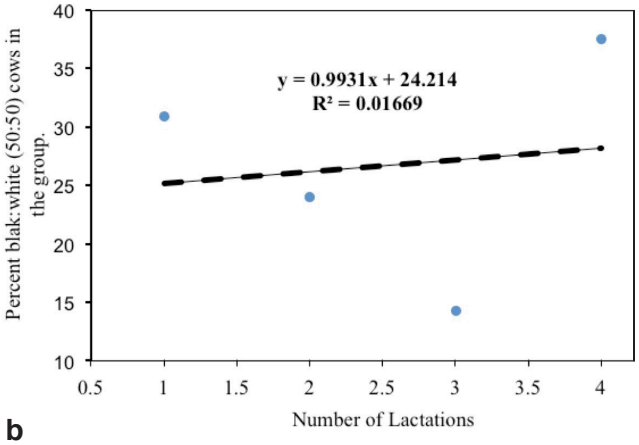
In terms of the relationship between hair coat color distribution (%) and number of lactations, the percentage of black cows in the herd increased with lactations for farm A (Figure 4a, b, and c). The percentage of white cows decreased with increasing lactations, while the population of black:white cows remained unchanged. Similar results were observed for farm B (Figure 5a, b, and c). The data suggest that cows with black hair coats had greater longevity in both herds. Similar observations have been reported in dairy herds in the US Virgin Islands (Godfrey and Hansen 1996). This phenomenon is puzzling since black color means greater absorption of heat (solar radiation). Heat stress has been found to result in lower milk production (Bohmanova et al. 2007). Rhoads et al. (2009) estimated that the breakdown for the lower milk production to lower feed intake was 35%, while the actual heat stress contributed to 65%.

The greater number of black cows found in the two herds may be explained by the fact that these animals have finer and shorter hair over the surface of the body, which can be see in Figure 6a, b, c, and d. This difference is reflected in the weight (μg) of the hairs per square centimeter (Figure 7). The shorter and finer hair texture reduces the "blanketing barrier" effect over the skin where sweating occurs (Gebremedhin et al. 2007). Thus it provides an environment for more efficient evaporative cooling compared to thicker hair, which would contribute more to the "insulation" phenomenon.

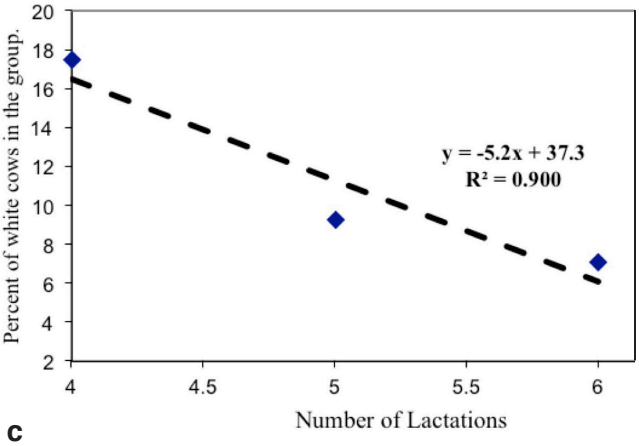
A subsequent study on sweating capabilities in Holstein cows further suggested a higher evaporative rate in black cows (Hillman et al. 2001). Cows with black hair coats also have black to dark grey skin under the hair coat, while white cows have pink skin (Figure 8). Since the hair follicle is cylindrical in shape, solar radiation would be reflected onto the skin as well as off the hair



a



b



c

Figure 4. Regression analyses of cows by hair coat color and number of lactations in Farm A. 4a. Cows with >90 black hair coat. 4b. Cows with black:white (50:50) hair coat. 4c. Cows with >90% white hair coat.

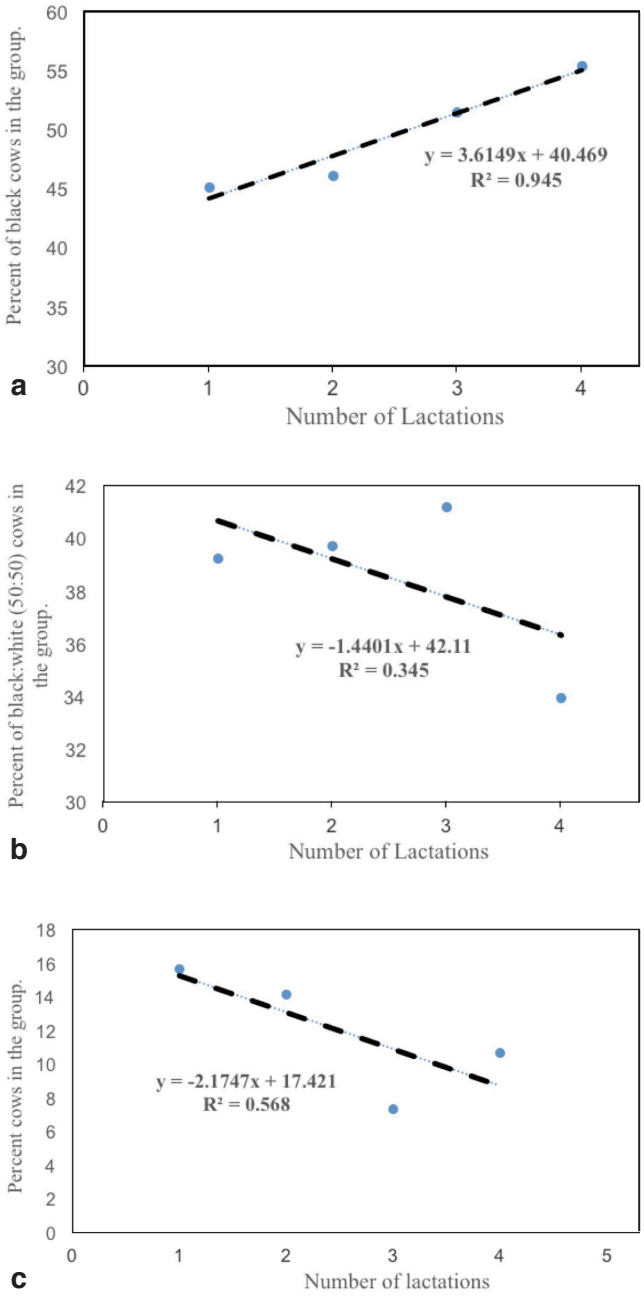


Figure 5. Regression analyses of cows by hair coat color and number of lactations in Farm B. 5a. Cows with >90% black hair coat. 5b. Cows with black:white (50:50) hair coat. 5c. Cows with >90% white hair coat.

surface. The pink skin under the white hair coat may explain why Holstein cattle in the tropics of Thailand were observed to have skin peeling off their backs if they were left out to forage for grasses under the hot sun. As a result, dairy farmers or their cooperatives selected against Holstein sires with white hair coats (personal experience when serving as director of marketing for Worldwide Sires Inc.).

The greater longevity or productive life of the black Holstein in the tropics makes up for the slightly lower milk production per lactation. It also adds to greater genetic gains within a herd due to greater reproduction (Moore et al. 1992). Hence, productive life of the animal within a herd and environment can help reduce the initial cost of raising the heifer and the potential gains in genetic progress.

Impact of Findings

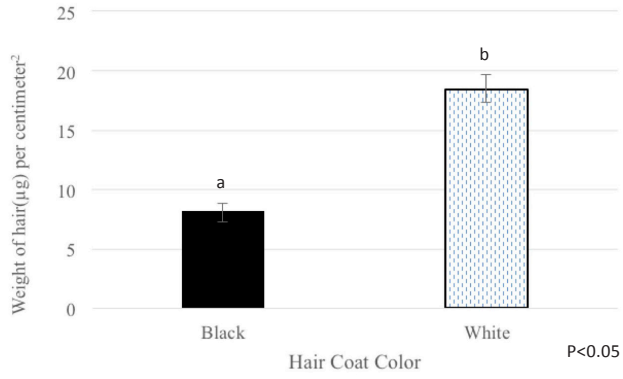
Since this study, we have conducted several subsequent studies on hair color, sweating rates, and hair coat characteristics on both beef and dairy cattle. The University of Florida studies suggest that the finer hair coat, which they termed "slick hair," is a dominant gene effect (Olson et al. 2003). Hence it would be possible to select animals with shorter and finer hair for the tropics. In addition, it may be advantageous to include skin with pigmentation vs pink as the latter may result in a "sunburn" effect.

Summary

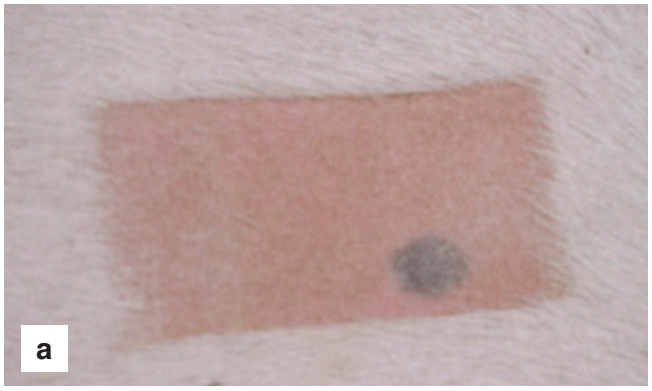
The data from this study suggest that hair coat color and texture could affect the longevity of dairy cows in the tropics. The productive longevity of an animal further affects the profitability of an operation, as it affects genetic gains and total lifetime production of the cow in the herd.

Acknowledgements

This study was made possible due to the efforts of the visiting scholar Dr. Baek and the collaboration of the dairy producers on O'ahu, Hawai'i. Special thanks to Andrew W.Y. Kok for laboratory assistance.



Above: Figure 6. Samples of white and black hair from Holstein cows. 6a. Cow 4300, hair from the thurl region. 6b. Cow 4300, hair from the shoulder area. 6c. Cow 561, hair from the thurl region. 6d. Cow 561, hair from the shoulder area. Left: Figure 7. Weight ($\mu g/cm^2$; mean ± SE) of black or white hair from Holstein cows taken from the thurl and shoulder region (n=11 per hair coat color). Below: Figure 8. The skin color under the hair coat of white and black Holstein cows. 8a. The skin under a white hair coat is pink. 8b. The skin under a black hair coat is grey to black. The images also show the difference in the characteristics of the hair: the white hair is coarse, thick, and long, while the black hair is short and fine.



References

Bohmanova, J., I. Misztal, and J.B. Cole. 2007. Temperature-humidity indices as indicators of milk production losses due to heat stress. *J. Dairy Sci*. 90:1947–1956.

Cassell, B. 2004. How do first, second and third lactation cows compare? Virginia Cooperative Extension publication. http://www.sites.ext.vt.edu/newsletter-archive/dairy/2004-02/lactation.html; accessed on Oct. 13, 2015.

Gebremedhin, K.G., P.E. Hillman, C.N. Lee, and R.J. Collier. 2007. Sweating rate of dairy cows under shade and sunny environments. ASABE Conf. Minneapolis, MN. Paper 074083.

Godfrey, R.W. and P.J. Hillman 1996. Reproduction and milk yield of Holstein cows in the US Virgin Islands as influenced by time of year and coat color. *Archivos Laintoamericanos de Production Animal* 4:31–44.

Hillman, P.E., C.N. Lee, J.R. Carpenter, K.S. Baek, and A. Parkhurst. 2001. Impact of hair coat on thermoregulation of dairy cows to direct sunlight. ASABE Conf. Sacramento, CA. Paper 014031.

Moore, R.B., J.W. Fuquay, and W.J. Drapala. 1992. Effects of late gestation heat stress on postpartum milk production and reproduction in dairy cattle. *J. Dairy Sci*. 75(7):1877–1882.

Olson, T.A., C. Lucena, C.C. Chase, Jr., and A.C. Hammer. 2003. Evidence of a major gene influencing hair length and heat tolerance in *Bos taurus* cattle. *J. Anim. Sci*. 81(1):80–90.

Rhoads, M.L., R.P. Rhoads, M.J. VanBaale, R.J. Collier, S.R. Sanders, W.J. Weber, B.A. Crooker, and L.H. Baumgard. 2009. Effects of heat stress and plane of nutrition on lactating Holstein cows: 1. Production, metabolism and aspects of circulating somatotropin. *J. Dairy Sci*. 92(5):1986–1997.

Stevenson, J. 2010. Heifers are still too old when they calve. *Hoard's Dairymen*. http://www.hoards.com/E_calf_heifer/HF08; accessed on Oct. 13, 2015.