Deutscher Tropentag 2002
Witzenhausen, October 9-11, 2002
Conference on International Agricultural Research for Development

Variation of skin colour among Holstein Friesian cows of Northern Thailand

N. Chongkasikit[a], T. Vearasilp[a], U. ter Meulen[b]

a Department of Animal Science, Faculty of Agriculture, Chiang Mai University, Chiang Mai 50200 Thailand E-mail: agisjtrs@chiangmai.ac.th

b Institute of Animal Physiology and Nutrition, Georg-August-University, Göttingen, Germany E-mail: umeulen@uni-goettingen.de

Abstract
In Northern Thailand there is an increase in the replacement of the heat stress adapted indigenous Thai cattle with improved breeds through crossbreeding with Holstein Friesian from temperate climates. The result is a tendency to a dairy cattle population with more dark skin color. Friesian cows with dark skins may have more difficulties to adapt because of the high humidity and temperatures. The percentage of black and white skin color in Holstein Friesian cows influences milk production. The black skin absorbs more environmental and solar radiation while the white reflects more. This predisposes black cows to more heat stress. Climatic stress especially from heat and solar radiation decreases milk production, changes milk composition and lowers reproductive performance. Therefore the skin color is of importance to dairy farming as it may cause significant economic losses. The objective of this study was to determine the distribution of dark skin color among 2,107 Friesian cows in Chiang Mai, Chiang Rai and Lamphun Provinces. The area of distribution of white and black colored patches on the entire body was measured.

The results revealed a wide variation in skin colour. The white colour had a mean distribution of 27% (±0.65 standard error), variance of 885.11, skewness of 0.96 and a median of 15%. Most of the cows had larger black than white coloured skin areas. In 50% of the cows, the white coloured skin areas covered less than 15%. The results suggest that the present Holstein Friesian population of Northern Thailand may not be well suited for this environment and should be investigated for heat stress.

Introduction
In recent years black and white Holstein-Friesians or their red and white genetic alternatives have become the preferred dairy breed in many countries. The primary reasons are dairy production economics and consumer preference for the low-fat milk which these cows produce (George, 1993).

In Northern Thailand there is an increase in the replacement of the heat stress adapted indigenous Thai cattle with improved breeds through crossbreeding with Holstein Friesian from temperate climates. The result is a tendency to a dairy cattle population with more dark skin color. Godfrey *et al.* (1994c) found that the percentage of black or white skin color in Holsteins influences milk production. Climatic stress especially from excessive heat and solar

radiation decreases milk production, changes milk composition and lowers reproductive performance. Solar radiation is a significant factor since it increases body temperature directly. In addition they found a 4.5 pounds increase in milk production for each 1 percent increase in white skin colored area in Holstein cows (Godfrey *et al.* 1994b). A larger white skin colored area also resulted in better reproductive efficiency under heat stress. This confirmed that predominantly white cows produce more milk than black cows, are of lower age at first parturition, have fewer days open and experience shorter calving intervals.

Cow color isn't just personal taste or aesthetics as, for example, in the case of a Holstein whose individual skin color is more black or more white. Biological differences among cows with different colors influence the cow's ability to cope with environmental stress from heat, humidity and solar radiation (Godfrey *et al.*, 1994a). Earlier research pointed out that there are physiological differences in adaptation and productivity, depending on the amount of black or white in the skin. Klungland *et al*. (1995) found that color of dairy cattle is controlled by 3 loci of gene EE, SS and S^{H-} as showed in table 1

The Holstein Friesian dairy breed (HF) has the genotype EEss whereas the Danish Red dairy breed (RDM) has the genotype eeSS. Crosses between HF and RDM become uniformly black. Some RDM have a different color pattern, tiger stripes, which are caused by an allele in the e locus, they dominate over red color. The Danish beef cattle breed Hereford has a white colored head with dominant inheritance. It is inherited from a dominant allele in the same locus as spotted color. The gene for spotted color is situated on chromosome 6, and is tightly linked with the kit gene with which it has interaction.

Table 1. Color controller genes in Dairy Cattle (Klungland *et al*.,1995)

Dominant		Recessive	
Colors	Genotypes	Colors	Genotype
Black	E-	Red	ee
Uniformly	S-	Spotted	ss
White Head	S^{H-}	Uniformly	SS

In Northern Thailand are black and white cattle are predominant because the main breed used for crossbreeding is Holstein Friesian. However, there is a wide variation in skin color. The objective of this study was to determine the distribution of skin color among the cattle.

Materials and Method

Experimental animals: 2,107 Dairy cows in small farms of Chiang Mai, Chiang Rai and Lanphun provinces.

Method: The area of distribution of white and black colored patches on the entire body was determined by looking at both sides of the cows and then estimate the percent of white color of each cow. The cows were divided into groups by percent of white color as shown in table 2.

Table 2. The groups of cows

Percent of white color	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Groups	1	2	3	4	5	6	7	8	9	10

Statistical Analysis: Mean, Standard deviation, Standard error of mean, variance skewness, standard deviation of skewness and median were used to estimate variation of skin color (SAS, 1990).

Results and Discussion

The average percent of white skin color (mean), Standard deviation (S.D.), Standard error (S.E.) of mean and variance were 27.00664, 29.75080, 0.64814 and 885.110 respectively as shows in table 3.

Table 3. Mean, S.D., S.E. and variance of white skin color in the population

N	Minimum %	Maximum %	Mean	Std. Deviation	Std. Error of Mean	Variance
2,107	0.00	100.00	27.00	29.75	0.65	885.11

Although the white color varied from 0% to 100 % among the cattle population most of the cows had more black colored patches than white. The mean was 27.00 % white skin color. Height of variance shows high variation of skin color in the population (table 3). The positive skewness in table 4 support the results in the table 3. The median of 15 shows that 50% of the cows in the population have less than 15% white color on their body.

Table 4. Skewness, Standard error of skewness and Median of percent of white color in population

Skewness	Std. Error of Skewness	Median
0.96	0.053	15.00

The distributions of cows into different groups according to percent of white skin color and are shown in figure 1. It also supported that most of cows in population have black color more than white color. A tendency of number of cows which have several percent of skin color were likely inverse proportion to percent of white color. This may explains that the cows with a few white color percent will have members in their group more than the cows which have many percent of white color.

The obtained results that the population of dairy cows in northern Thailand have predominantly dark skins show that these cows may have difficulties to adapt to the environment because of the high humidity and temperatures (heat stress). The solar radiation absorption of black colored skin is comparably higher than of white skin which leads to a high skin temperature (Godfrey *et al.*, 1994a) which affect body temperature. This causes the cattle to decrease fed intake and may affect reproduction and milk production of the cows.

Conclusion

The variation of skin color in the population were high. The percent of white color ranged from 0 % until 100 %. Most of the cows had larger black than white colored skin areas. In 50% of the cows, the white colored skin areas covered less than 15%. The results suggest that the present Holstein Friesian population of Northern Thailand may not be well suited for this environment and should be investigated for heat stress.

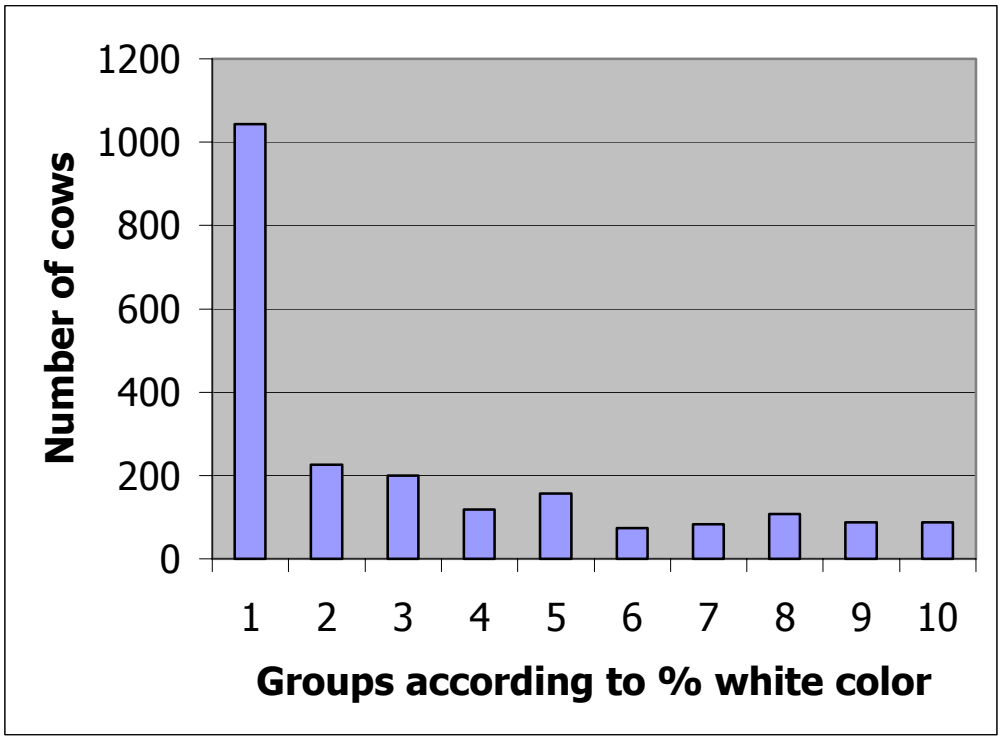

Figure 1. Distribution of cows according to % of white color

References

George F. W. (1993). What Color Should Cows Be. Dairy management column http://bluehen.ags.udel.edu/deces/dairycol/dc11-93.htm. [24 October 2001].

Godfrey, R. W. and P. J. Hansen. (1994a). Seasonal influences on reproductive patterns of dairy cows in the tropics. J. Anim. Sci. 72 (Suppl. 2):13.

Godfrey, R. W. and P. J. Hansen. (1994b). Effects of skin color on production and reproduction of dairy cattle on St. Croix. Proc. Caribbean Food Crop Soc., 30:180-185.

Godfrey, R. W. and P. J. Hansen. (1994c). Environmental influences on reproduction and milk production of Holstein cows on St. Croix. UVI Research 6:10-12.

Klungland (1995). Memalian Genome 6:636-39.

SAS. (1990). User's Guide. SAS Institute Inc.