Effects of Air Temperature and Humidity on Average Daily Gain for Different Genotype Feedlot Cattle Corresponding Author

[1]Kemal Yazgan and [2]Cihan Datanbek
[1]Department of Animal Science, Faculty of Agriculture, Harran University, Sanliurfa, Turkey
[2]Department of Animal Science, Faculty of Agriculture, Ankara University, Ankara, Turkey

Key words: Feedlots, cattle, air temperatures, humidity, heat stress, Turkey

Corresponding Author:
Kemal Yazgan
Department of Animal Science, Faculty of Agriculture, Harran University, Sanliurfa, Turkey

Page No.: 49-57
Volume: 15, Issue 8, 2016
ISSN: 1680-5593
Journal of Animal and Veterinary Advances

Abstract: The aim of this study to compare THI method using by average, minimum or maximum temperature and humidity and to compare the Holstein (H), Brown Swiss (BS), Simmental (S) and Anatolian Black Cross (ABC) genotypes using in feedlot by ability to tolerate temperature and humidity under climatic conditions of Sanliurfa province of Turkey. Production data set obtained by a commercial farm which consisted 70,594 test day records for 11,117 cattle (6513 Holstein, 3546 Brown Swiss, 838 Simmental and 220 Anatolian Black Crosses). Weather data provided the nearest weather station and 9.04 km away from to feedlot. Using daily maximum, minimum and average air temperature and humidity values, Temperature-humidity Index (THI) values were calculated by three different combinations for each animal. Analyses were based on model that included effects of year, sex, age, season, days on feed, begin to fattening and several types of THI. According to findings, S and ABC genotypes slightly more tolerated the heat stress compared with H and BS. In addition to BCgenotype was more sensitive to cold stress when compared other genotypes. On the other hand using different combination of temperature and humidity variable (max or min) in THI formula obtained different breakpoint values for stress and comfort zone interval. 72 THI values which is a threshold for starts of heat stress obtain using only maximum temperature and minimum humidity variables in this study. Results from this study indicated that trend of temperature and humidity in the air were determinant factors for THI calculation types when used data from the weather stations.

INTRODUCTION

Performance, welfare and health of the animal are influenced by metrological factors. Most important climatological factors are high temperatures and relative humidity during the hot season and the wind chilling factor during the cold season (Broueek *et al*., 2006). Summer conditions consisting above normal ambient

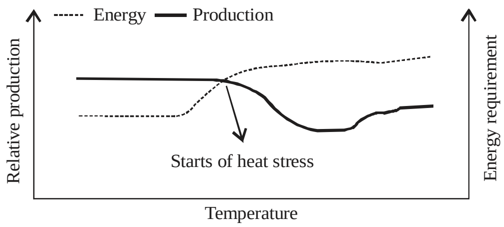

Fig. 1: Production curve of animals affected by heat stress and energy requirements

temperature, relative humidity and solar radiation coupled with low wind speed can increase animal heat load, resulting in reduced performance, decreased animal comfort and death (Mader *et al*., 2006).

Considering the increase of global warming, this situation is very clear that it will more serious problem for live stock. Similar to other farm anima l when feed lot cattle exposed heat stress heat loss mechanism is activated and resulted with increasing aspiration and sweating. High relative humidity reduces evaporation and makes dissipation of body heat more difficult as the environmental temperature nears the cow's body temperature (West, 1994). Vaporization from the respiratory tract and the outer body surface is affected directly by the temperature and relative humidity of the air (Kibler and Brody, 1953; West, 1994). Such as stress conditions and metabolic activations is caused product and economic losses due to needs of increase energy. According to NRC (2001); increasing of panting score, resulted that raised to energy requirement 7-25% (Serbester, 2007). This is simulated as shown in Fig. 1. Ravagnolo *et al*. (2000) reported that for test day yield, depression caused by heat is a function of the top, average or lowest temperatures and humidity during the 24 h preceding recording; the management style, including the availability of anti heat stress measures (e.g., sprinklers, shading and fans) the duration of the current heat stress and the duration of previous heat stresses.

There are many approaches to quantify heat stress from complex formulas to simpler methods such as Temperature Humidity Index (THI) (Igono *et al*., 1992; Linvill and Pardue, 1992; Ravagnolo *et al*., 2000). THI is used instead of the temperature itself (Ingram, 1965; Sleger and Neuberger, 2006) and various THI have been developed by using dry bulb temperature in combination with wet bulb temperature, relative humidity or dev point (Buffington *et al*., 1981; Roseler *et al*., 1997; Gaughan *et al*., 2008). THI can be calculated by joined temperature and humidity into one value as the following expression (Thom, 1959; National Oceanic and Atmospheric Administration; 1976):

$$\text{THI} = \left(\begin{matrix}0.8\times\text{ambient}\\ \text{temperature°C}\end{matrix}\right) + \left\{\left[\begin{matrix}\dfrac{(\text{relative humidity})}{(100)}\times\\ (\text{ambient temperature°C-14.3})\end{matrix}\right] + 46.3\right\}$$

According to this formula, heat stress is started at a THI of 72 which corresponds to 22°C at 100% humidity, 25°C at 50% humidity or 28°C at 20% humidity. In addition to knowledge of THI alone is beneficial in determining the potential for heat stress for feedlot cattle (Mader *et al*., 2006).

In Holsteins, resulted of intensive selection programs carried out mostly in temperate climates worldwide, reduced heat tolerance due to productivity and heat tolerance antagonism. Hammond reported that heat tolerance in F_1 crosses of tropically adapted b reeds (Tuli, Senepol and Brahman) with a temperate breed (Angus) is similar to heat tolerance displayed by purebred tropical breeds (Senepol and Brahman). On the other hand, Gaughan *et al*. (1999) are reported that Hereford χ Boran and Hereford χ Tuli are similar to Hereford χ Brahman and intermediate to Hereford and Brahman genotypes in maintaining homeostasis when exposed to high heat load.

Anatolian Black is a native genotype of Turkey and one of most popular breed in this country. It is hardy, disease resistant and tolerant of poor care, meager diet and adverse climate conditions. In this research Anatolian, Black cattle which crossbreed other genotypes (With Holstein, Simmental and Brown Swiss) were used. Because of the fact that there wasn not a definite information (That which genotype crossbreed with Anatolian Black) about crossbreeding process of these animalin this research grouped and named as Anatolian Black Cross.

Sanliurfa province is located in southeastern region of Turkey and one of the hot places of the country. Especially summer time, weather temperatures reaches over 38ºC. Ravagnolo and Misztial (2000) proposed a model that accounts for heat stress using Test-Day (TD) milk yield records and weather data from public weather stations (Bohmonova *et al*., 2008). Using this method, various study were conducted about heat stress on milk yield by Ravagnolo and Misztial (2000), Ravagnolo *et al*. (2000), Broueek *et al*. (2006), Bohmonova *et al*. (2008) and Aguilar *et al*. (2009).

The aim of this study, using a similar method is: To calculate the temperature and humidity effect on Average Daily Gain (ADG) taking into account Test-day) To compare THI method using by average, minimum or maximum temperature and humidity) To compare the Holstein (H), Brown Swiss (BS), Simmental (S) and Anatolian Black Cross (ABC) genotypes using in feedlot by ability to tolerate temperature and humidity under climatic conditions of Sanliurfa.

MATERIALS AND METHODS

Production data set using in this study were obtained from a commercial feedlot which is one of the biggest

Table 1: Description of production data by genotype

H	6.513	38.371	1238±1.4
BS	3.546	25.111	1222±1.7
S	838	5.666	1263±3.6
ABC	220	1.446	1199±7.2
Total	11.117	70.594	-

ADG: Average daily gain (g), SE: Standard error. H: Holstein, BS: Brown Swiss, S: Simmental, ABC: Anatolian Black Cross

farms in Turkey located in Sanliurfa province (37° 08' 48" North latitude and 39° 05' 40" east longitude). The feedlot had a capacity of 13,000 cattle. Across all feedlots stocking density varied from 9-9.9 m^2/animal and infeedlot all animals are shaded. As canopy material used 0.50 mm white color trapezoidal sheet and height of the shade structures ranged from 4.20-8.00 m.

The hottest days of the year provided shower to animals with hose praying system. H, BS, snd ABC genotypes were used as fattening material and animals were weighed on average every 33 days by ±1kg sensitivity. Cattles had *ad libitum* access to feed (~13.1 % crude proteins and 2660 kcal kg^{-1} ME)and water. Using material in diet were corn, barley, soybean-meal, wheat bran, molasses, cottonseed-meal, corn bran, sunflower seed-meal, wheat straw, corn and wheat silage, limestone, vitamin-minerals premix and salt. Although, to substitute one for another materials using in diet, energy and crude protein levels were fixed every time.

Data set comprised 108,334 test day records of 12,504 cattle. Each cattle was required to have at least 4 test day records to be part of the analysis. Average daily gain (g) for each cattle calculated by test day intervals as follows:

$$ADG_n = \frac{TD_n - TD_{n-1}}{t_n - t_{n-1}} \times 1000$$

Where:
ADG_n = The average daily gain nth interval (g)
Td_n = The nth test day record (kg)
t = The time (day)

Records with ADG <300 g or ADG >1800 g (represent anomaly record due to sickness or other feeding problem) eliminated from the data. Thus, production data set consisted 70, 594 test day records for 11, 117 cattle (n = 6513 H, n = 3546 BS, n = 838 S and n = 220 ABC). Distributions of records by genotype are shown in Table 1.

Weather data using in this research provided the nearest weather station to feedlot located at in Harran University Campus Agriculture, Faculty Drupe and Pome Fruits R and D and Gardening unit. Distance between weather station and feedlotpoint to point (As the crow flies) is 9.04 km. Air temperature (max and min), relative

Table 2: Description of weather data between 2008-2009 years

	Mean		
Items	Maximum	Average	Minimum
Daily temperature (°C)	24.66	18.24	11.82
Daily Humidity (%)	65.21	46.56	27.90

humidity (%), wind directions and speed (m/sec), air press (mm Hg), solar radiation (W m^{-1}) and other meteorological events is measured and recorded asdaily since 2005 in this weather station. To reduce the complexity of the analyses the effect of temperature and humidity was studied and other climatic information was ignored. Summary of the basic statistics of the weather data set between 2008-2009 years are shown in Table 2. Using daily maximum, minimum and average air temperature and humidity values, THI types were calculated by three different combinations with following equation proposed by Thom (1959):

$$THI = (0.8 \times (t_a) + \{[(rh/100) \times (t_a - 14.4)] + 46.54\}$$

Where:
THI = The Temperature-humidity Index
ta = The ambient temperature in degrees Celsius
rh = The relative humidity (%)

Accordingly, THI-1, THI-2 and THI-3types calculated using maximum temperature and minimum humidity, average temperature and humidity and finally maximum temperature and humidity values, respectively. Because of test day yields reflect the effect of the previous period (Ravagnolo *et al*., 2000), using temperature and humidity mean (maximum, average or minimum) values which correspond to interval of test day records of each animal, THI-1, THI-2 and THI-3 types were calculated individually. Additionally, Fig. 2-4 show that mean of THI-1, THI-2 and THI-3 index values each day of the year (averaged 2 year) for the present data set. In order to calculate temperature-humidity effect on ADG and obtain least square means for each THI types following model was used:

$$y_{ijklmn} = \mu + yr_i + s_j + a_k + se_l + DOF_m + THI_n + bW_{ijklmn} + e_{ijklmn}$$

Where y_{ijklmn} day yield for year i (I = 2008 and 2009), sex j (j = 1 and 2), age k (k = 3 month, 4 through 6, 7 through 9,…, 22 through 24 and >24), season l (l = 1,2,3,…, 12), days on feed m (m = 1, 2, 3, …, 15), temperature humidity index n ; µ = over all mean; yr = year effect; s = sex effect; a = age effect; se = season effect; DOF = effect of Days On Feed class; THI = Temperature-humidity Effect; W = Weight at the begin to fattening; b linear regression coefficient; e = random

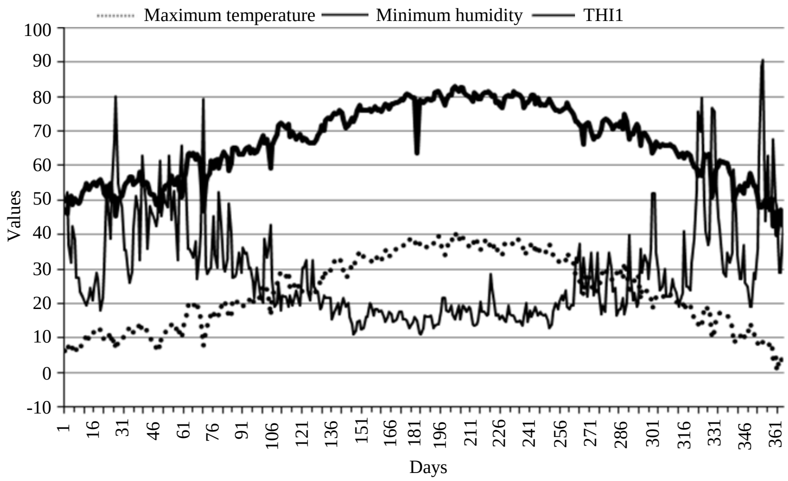

Fig. 2: THI-1 values calculated with maximum daily temperature and minimum daily humidity

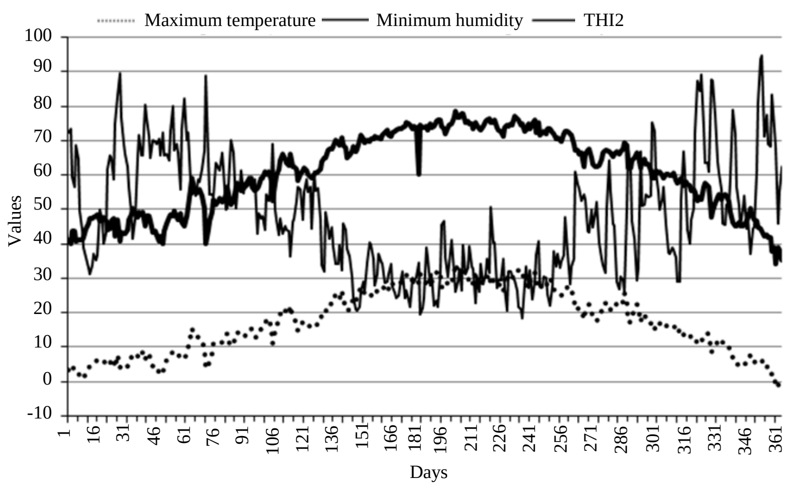

Fig. 3: THI-2 values calculated with average daily temperature and humidity

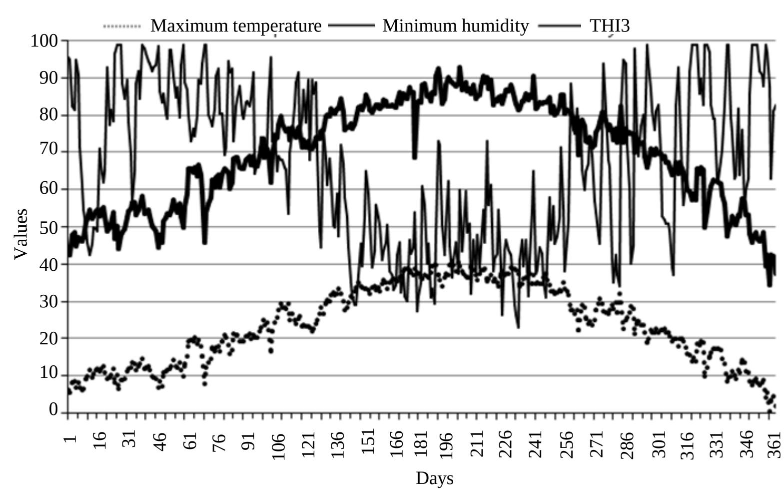

Fig. 4: THI-3 values calculated with maximum daily temperature and humidity

residual error. Arrangement production and weather data, calculation mean value of temperature and humidity variables by test day interval of each animal and all analyses were conducted with various command and GLM procedure of SAS (1996).

RESULTS AND DISCUSSION

In all analyses all fixed effects were detected significantly. As shown in Table 3 all coefficients of determination values (R^2) are small. As shown in Table 3, R^2 and Root MSE values of THI-1THI-2 and THI-3 within genotypes were close to each other. In addition, to compared R^2 and Root MSE values of genotypes for each THI types, ABC were highest and S, BS and H followed this, respectively. R^2 and Root MSE values (Shown in parentheses) obtained from H lowest and for THI-1THI-2 and THI-3 types were 0.053 (271.21), 0.055 (270.93) and 0.054 (271.10), respectively. These results pointing to only a small part of yield variation is explained by the temperature and humidity variables. Although, these findings were similar with reported by Ravagnolo *et al*. (2000), R^2 values for all THI methods were slightly higher in the study for H genotype. That both studies focus on different types of yields may have caused this difference between two studies.

As shown in Table 3, considered with together THI variables and genotype, THI-2 provided highest R^2 (0.055 and 0.290) and lowest Root MSE (270.93 and 263.59) for H and ABC genotypes, respectively. But other THI variables very close to these values. Similarly, THI-3 provided highest R^2 (0.108 and 0.139) and lowest Root MSE (254.01 and 258.83) for BS and S genotypes, respectively.

Figure 5 shows least square means and for test day average daily gain for THI-1. As shown in Fig. 5 for all genotypes average daily gain raised up to 63 THI-1 and then fluctuating observed until about 72 THI-1 which also is the end of the comfort zone for cattle (Armstrong, 1994). After 72 THI-1, average daily gain values for H and BS decreased significantly ($p<0.01$) until about 75 THI-1 and similarly for S and ABC decreased significantly ($p<0.01$) until about 78 THI-1. After this point when increased THI-1 values, average daily gains contrary to expectations increased too. This upward trend can be explained with tolerating heat stress by cattle because of when the temperature increase, moisture in the air decreasing regularly (Fig. 2-4). Similar findings reported by Ravagnolo *et al*. (2000). Also meteorological data is supported this conclusion.

During production at the feedlot while the average daily maximum temperature was 24.66°C, average daily

Table 3: Coefficient of determination and root mean square error (Root MSE) for different temperature-humidity index by genotype

	Genotype							
	H		BS		S		ABC	
Items	R^2	Root MSE	R^2	Root MSE	R^2	Root MSE	R^2	Root MSE
THI-1[a]	0.053	271.21	0.106	254.23	0.137	259.09	0.284	264.52
THI-2[b]	0.055	270.93	0.107	254.15	0.137	259.08	0.290	263.59
THI-3[c]	0.054	271.10	0.108	254.01	0.139	258.83	0.289	263.86

[a]Maximum temperature and minimum humidity; [b]Average temperature and humidity; [c]Maximum temperature and humidity; H: Holstein, BS: Brown Swiss, S: Simmental, ABC: Anatolian Black Cross

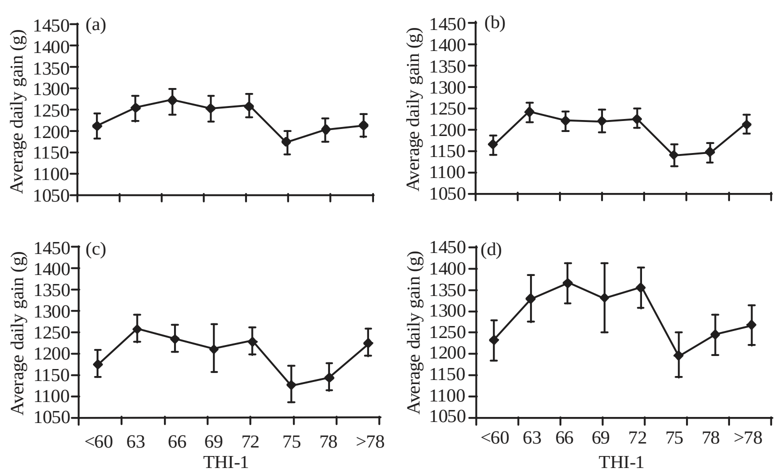

Fig. 5(a-d): THI-1for maximum temperature and minimum humidity for average daily gain by genotype; (a) H (n = 38371), (b) BS (n = 25111), (c) S (n = 566) and (d) ABC (n = 1446)

Table 4: Least square means and standard errors of average daily gain for THI-1, THI-2 and THI-3by genotype*

	Genotype			
Variables	H Mean±SE	BS Mean±SE	S Mean±SE	ABC Mean±SE
THI-1				
<60	1211.6±27.61^{ab}	1164.8±19.56^{a}	1179.6±29.24^{a}	1229.6±42.74^{a}
63	1253.5`±28.36^{c}	1239.6±21.13^{b}	1261.3±34.21^{b}	1322.8±52.89^{abcd}
66	1270.0±27.78^{c}	1219.4±20.04^{b}	1238.9±31.02^{bc}	1356.5±48.95^{b}
69	1252.0±30.80^{cdfb}	1219.7±24.79^{b}	1214.9±54.44^{abcd}	1223.9±76.80^{abcd}
72	1258.8±27.77^{c}	1224.6±19.86^{b}	1232.7±30.08^{bc}	1347.2±47.09^{abc}
750	1170.0±28.66^{e}	1140.9±23.48^{a}	1132.9±42.15^{acd}	1195.4±80.98^{abcd}
78	1199.1±27.64^{ae}	1147.7±19.64^{a}	1148.1±29.75^{ad}	1239.3±42.76^{d}
>78	1211.1±27.70^{ab}	1212.0±19.99^{b}	1230.4±30.37^{bc}	1261.8±44.81^{abcd}
THI-2				
<54	1213.3±27.59^{af}	1166.8±19.54^{ag}	1188.1±29.29^{a}	1229.3±42.49^{a}
57	1289.6±27.94^{b}	1269.5±20.64^{b}	1282.3±32.64^{b}	1412.0±51.13^{b}
60	1259.9±28.06^{c}	1201.8±20.38^{e}	1244.6±32.32^{bc}	1305.4±54.07^{ab}
63	1274.9±31.18^{bcdg}	1212.6±25.84^{abef}	1184.7±70.04^{ba}	1280.5±83.83^{ab}
66	1261.8±27.76^{cd}	1225.2±19.89^{ce}	1237.4±30.23^{bcd}	1352.7±47.11^{bc}
69	1172.9±28.63^{e}	1144.8±24.18^{afg}	1136.2±43.91^{ace}	1180.2±86.72^{ab}
72	1204.7±27.66^{f}	1156.0±19.69^{g}	1162.7±30.17^{a}	1240.4±43.36^{a}
75	1188.7±27.80^{ef}	1161.6±20.40^{ahg}	1182.4±31.59^{ac}	1289.7±49.05^{ab}
78	1227.1±27.92^{ag}	1218.3±20.53^{de}	1250.5±33.13^{bce}	1232.3±48.84^{ac}
THI-3				
<63	1208.8±27.59^{ai}	1163.7±19.52^{a}	1180.0±29.23^{afh}	1221.3±42.52^{a}
66	1279.4±28.01^{b}	1253.8±20.63^{b}	1283.9±32.32^{bc}	1348.1±49.80^{b}
69	1247.4±27.87^{cdef}	1206.5±20.13^{c}	1216.2±31.64^{acg}	1326.7±51.09^{ab}
72	1223.9±37.67^{abefgh}	1227.1±26.27^{bcd}	1216.0±62.11^{bdgf}	1095.7±91.70^{ab}
75	1270.5±28.00^{bef}	1214.6±20.69^{cde}	1212.9±32.55^{bdgh}	1368.7±50.33^{bc}
78	1226.8±27.93^{adh}	1224.6±20.21^{bcdefg}	1246.2±32.16^{bdeg}	1296.6±52.68^{ab}
81	1212.9±29.09^{chgi}	1154.2±23.37^{ag}	1154.9±42.75^{fg}	1229.6±92.25^{ab}
84	1186.4±27.60^{g}	1139.5±19.64^{g}	1141.8±29.72^{f}	1220.8±42.96^{ad}
87	1219.3±28.06^{hi}	1220.1±20.77^{bcdeh}	1223.1±32.84^{agb}	1279.5±47.40^{ab}
>87	1221.9±27.85^{hi}	1207.1±20.32^{cdeh}	1237.2±32.30^{agb}	1222.8±49.95^{ab}

*Means with not the common letter are significantly different (p<0.01). H: Holstein, BS: Brown Swiss, S: Simmental, ABC: Anatolian Black Cross

minimum humidity in the air was only 11.82% in Sanliurfa (Table 2). Secondly, using heat-abatement system such as hose-spraying could be helped to rises. As shown in Table 4 when THI-1 valueraised 72 (End of comfort zone) to 75 for H and BS genotypes average daily gain loss was about 89 and 84 g (p<0.01), respectively. Whereas for S and ABC genotypes significantly average daily gain losses started at 78 THI-1and calculated about 84 and 108 g (p<0.01), respectively. On the other hand, averages daily gain loses were close to each other for all genotypes.

As in shown Fig. 5, ADG raised from <60 THI-1 point up to 63 THI-1 value. On other words, 63 THI-1 value indicating that was a break point for starting comfort zone for H, BS and S genotypes and ADG differences were about 42, 74.8 and 81.7 g, respectively (p<0.01) for three genotypes (Table 4). In terms ofADG, there was not statistically significant between <60 and 63 THI-1 values for ABC genotype (p>0.05). In Fig. 2 when THI-1 value <63 (Between 1-76th and 317-365th days) air temperatures were about between 0-20°C whereas, air humidity were about between 18-90% and average 50%. Relatively low air temperature and high humidity can be causedstress conditions and metabolic activations is caused ADG losses due to needs of increase energy (Fig. 1) for H, BS and S genotypes. Similar findings were reported by Brouèek *et al.* (2006). According to these findings, it can be possible to say that S and ABC genotypes slightly more tolerated the heat stress compared withH and BS genotypes. In addition, longest comfort zone interval detected as 63-72 for H and BS genotypes, 63-75 for S genotype and 66-75 for ABC genotype when calculated of temperature humidity index based on maximum temperature and minimum humidity.

Figure 6 shows least square means and for test day ADG for THI-2. ADG rose from <54 THI-2point up to 57 THI-2 value. Different from THI-1 method, 57THI-2 value indicating that was a break point for starting comfort zone and ADG differences between <54-57 THI-2 were about 76, 102, 94 and 182 g, respectively (p<0.01) for all genotypes (Table 4). These results indicated that ABC was much more sensitive to cold stress than other genotypes and BS, S and H followed this when calculated of temperature humidity index based on average temperature and humidity. As in shown Fig. 6, differently from THI-1 method, end of comfort zone detected as 66 for H, BS and S. For H, ADG loses which >66 THI-2 detected as statistically significant (p<0.01). On the other hand these stress zones proceed until 75 THI-2 for BS and 72 THI-2 for S. And similar to H, ADG

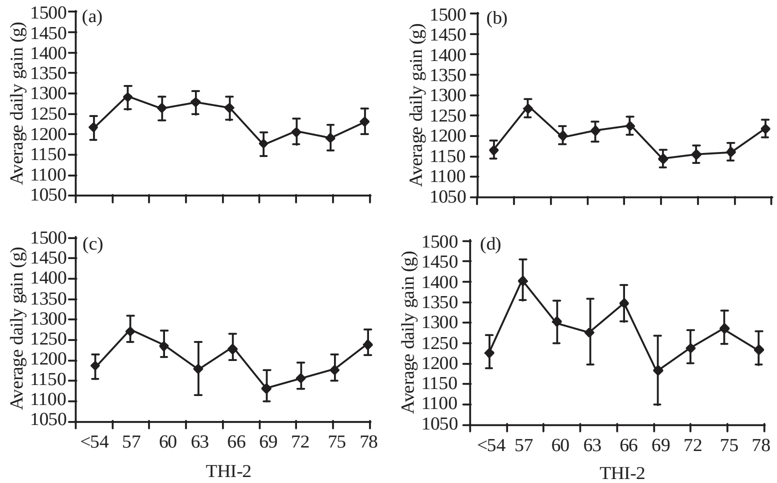

Fig. 6 (a-d): THI-2 for average temperature and humidity for average daily gain by genotype; (a) H (n = 38371), (b) BS (n = 25111), (c) S (n = 566) and (d) ABC (n = 1446)

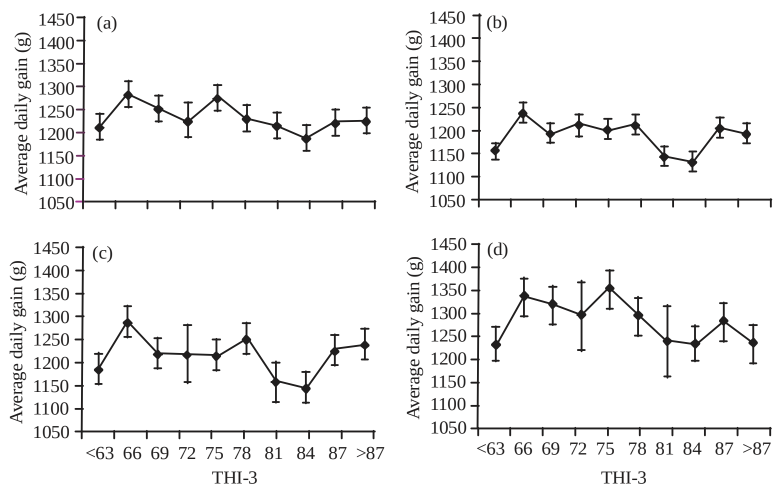

Fig. 7(a-d): THI-3for maximum temperature and humidity for average daily gain by genotype; (a) H (n = 38371), (b) BS (n = 25111), (c) S (n = 566) and (d) ABC (n = 1446)

loses along stress zones were statistically significant (p<0.01) (Table 4). For ABCgenotype, ADG despite a sharp decline after 66THI-2 this declines were not statistically significant (p>0.05) for all values which >66 THI-2 (Table 4). Similar to the findings obtained from THI-1, it can be said that S and ABC genotypes more tolerated the heat stress compared with H and BS genotypes when calculated of temperature humidity index based on average temperature and humidity.

Figure 7 shows least square means and for test day average daily gain for THI-3. ADG rose from <63 THI-3 point up to 66 THI-3 value. Different from THI-1 and THI-2, 66 THI-3 value indicating that was a bre 0.ak point for starting comfort zone and ADG differences between <63-66 THI-3 were about 70, 90, 104 and 126 g, respectively (p<0.01). Similar to THI-2 method, ABC was more sensitive to cold stress than other genotypes and S, BS and H followed this genotype. After 75 THI-3 for H, pronounced heat stress zone detected until 84 THI-3. This stress period occurred between 81-84 THI-3 for BS. Although there was a concavity after 78 THI-3 as in shown Fig. 7 for S genotype, only 84 THI-3 (p<0.01) detected as a stress point (Table 4). Similar this, same stress point was detected for ABC (p<0.01). Other words there wasn’t a long stress zone for S and ABC genotypes when calculated of temperature humidity index based on maximum temperature and humidity. Regardless of THI types, S and ABC genotypes were more tolerated the heat stress compared with H and BS genotypes. And ABC genotype was more sensitive to cold stress when compared other genotypes.

However when compared all THI types, points of start and end of comfort zones were different (Fig. 5-7). These results indicating that using differenttemperature and humidity variables (max or min) are reveal the different THI values for start and end of comfort/stress zone for genotypes. This situation could be explained by temperature and humidity values reachto extremepoint?? (max or min)differenttimes during day where placed the farm. In addition as in shown Fig. 3 and 4, extremely fluctuations were seen on humidity curve whereas; fluctuations of temperature curve were much less throughout days.

Because of this factors using different combination of temperature and humidity variable (max or min) in THI formula obtained different break point values for stress and comfort zone interval. In this study, standard 72 THI values which was threshold for start of heat stress, obtained with only THI which was calculated with maximum temperature and minimum humidity variables mentioned earlier. Considering all THI types there was fluctuations on the average daily gain curves throughout comfort zones for all genotypes. These fluctuations could also be caused by inadequate record with a given THI types by partial confounding with other effects in model and by omitting the management information.

Mader *et al*. (2006) reported that a THI between 70 and 74 is an indication to producers that they need to be aware that the potential heat stress in livestock exists and THI values = 74 are classified as alert, 74 < THI < 79 as danger and 79 = THI = 84 as emergency for Angus feedlot cattle.These findings were similar with the results especially when used THI-1 and THI-3. However when used THI-2 alert point of index find lower in this study for H, BS and S. it can becaused by using average temperature and humidity values in this study as mentioned earlier. In addition both study were shown that there wasn not large different of THI values to start the heat stress between dairy and feedlot cattle.

In this study, loss of production observed was low relatively. This situation could have been caused by simplifications in this study. First, the weather temperature and humidity were measured away from the farm (9.04 km). Second, mean values of temperature and humidity variables were used between test day records in order to calculate the weather effect to test day.Third, large effect on test day performance that was not included for in the study was caused by the use of heat the abatement system such as canopy and sprinklers. Because of there is no adequate and numerical data about sprinklers such as duration and timing, this effect could not use in the model. So, it is possible that hotter days with heat abatement measures used are less stressful for cattle than cooler days without applications of such measures.

CONCLUSION

In this research used meteorological data from weather station and it can be possible to say that contain useful information for research about calculation the temperature and humidity effect on ADG for feedlot cattle. Heat and cold stress negatively affects weight gaining of feedlot cattle in Sanliurfa. Regardless of THI types, S and ABC genotypes were more tolerated the heat stress compared with H and BS genotypes. Also ABC genotype was more sensitive to cold stress when compared other genotypes. High and low temperature tolerated by cattle to a degree however, increase the amount of moisture in the air resulted with low tolerance.

Results from this study indicated that trend of temperature and humidity in the air were determinant factors for THI calculation types when used data fromthe weather stations. This study was carried out with only one herd and could be repeated with more herds with THI hourly that calculated with hourly recorded temperature and humidity values but also sheltered unshaded herds.

ACKNOWLEDGEMENTS

The researcher thank Assist. Prof. Dr. Ali Ikincifrom Drupe and Pome Fruits R and D and Gardening unit of Harran University Agriculture Faculty for providing weather data.

REFERENCES

Aguilar, I., I. Misztal and S. Tsuruta, 2009. Genetic components of heat stress for dairy cattle with multiple lactations. J. Dairy Sci., 92: 5702-5711.

Armstrong, D.V., 1994. Heat stress interaction with shade and cooling. J. Dairy Sci., 77: 2044-2050.

Bohmanova, J., I. Misztal, S. Tsuruta, H.D. Norman and T.J. Lawlor, 2008. Short communication: Genotype by environment interaction due to heat stress. J. Dairy Sci., 91: 840-846.

Broucek, J., S. Mihina, S. Ryba, P. Tongel, P. Kisac, M. Uhrincat and A. Hanus, 2006. Effects of high air temperatures on milk efficiency in dairy cows. Czech J. Anim. Sci., 51: 93-101.

Buffington, D.E., A. Colazon-Arocho, G.H. Canton, D. Pitt, W. W. Thatcher and R. J. Collier, 1981. Black globe-humidity index (BGHI) as comfort equation for dairy cows. Trans. Am. Soc. Agric. Eng., 24: 711-714.

Gaughan, J.B., T.L. Mader, S.M. Holt and A. Lisle, 2008. A new heat load index for feedlot cattle. J. Anim. Sci., 86: 226-234.

Gaughan, J.B., T.L. Mader, S.M. Holt, M.J. Josey and K.J. Rowan, 1999. Heat tolerance of boran and tuli crossbred steers. J. Anim. Sci., 77: 2398-2405.

Igono, M.O., G. Bjotvedt and H.T.S. Crane, 1992. Environmental profile and critical temperature effect on milk production of holstein cows in desert climate. Int. J. Biometeorol., 36: 77-87.

Ingram, D.L., 1965. Evaporative cooling in the pig. Nature, 207: 415-416.

Kibler, H.H. and S. Brody, 1953. Influence of humidity on heat exchange and body temperatureregulation in Jersey. H, Brahman and Brown Swiss cattle. Missouri Agric. Exp. Sta. Bull. 522, Columbia.

Linvill, D.E. and F.E. Pardue, 1992. Heat stress and milk production in the South Carolina coastal plains. J. Dairy Sci., 75: 2598-2604.

Mader, T.L., M.S. Davis and T. Brown-Brandl, 2006. Environmental factors influencing heat stress in feedlot cattle. J. Anim. Sci., 84: 712-719.

NRC., 2001. Nutrient Requirements of Dairy Cattle. 7th Edn., National Academies Press, Washington, DC., USA., ISBN: 0309069971, Pages: 381.

National Oceanic and Atmospheric Administration, 1976. Livestock hot weather stress. Regional Operations Manual Letter C-31-76.US Dep. Commerce, Natl. Oceanic and Atmospheric Admin., Natl. Weather Service Central Region, Kansas City, Missouri.

Ravagnolo, O. and I. Misztal, 2000. Genetic component of heat stress in dairy cattle, parameter estimation. J. Dairy Sci., 83: 2126-2130.

Ravagnolo, O., I. Misztal and G. Hoogenboom, 2000. Genetic component of heat stress in dairy cattle, development of heat index function. J. Dairy Sci., 83: 2120-2125.

Roseler, D.K., D.G. Fox, L.E. Chase, A.N. Pell and W.C. Stone, 1997. Development and evaluation of equations for prediction of feed intake for lactating H dairy cows. J. Dairy. Sci., 80: 878-893.

SAS, 1996. User's Guide: Statistics. Statistical Analysis Systems Institute, Inc., Cary, NC., USA.

Serbester, U., 2007. Effects of dietary energy and protein sources and sprinkler treatment on milk yield and milk composition of dairy cows under high temperature. Ph.D. Thesis, Department of Animal Science Institute of Natural and Applied Sciences University of Cukurova, Adana.

Sleger, V. and P. Neuberger, 2006. Using meteorological data to determine the risk of heat stress. Czech J. Anim. Sci., 52: 39-47.

Thom, E.C., 1959. The discomfort index. Weatherwise, 12: 57-61.

West, J.W., 1994. Interactions of energy and bovine somatotropin with heat stress. J. Dairy Sci., 77: 2091-2102.