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THE RESISTANCE OF BRAHMAN CROSS CATTLE IN PADANG CITY, WEST SUMATRA

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ABSTRACT

The research aims to determine Brahman cross (BX) cattle's heat resistance at the UPT Aia Pacah, Padang, West Sumatra. The research variables were the "Temperature Humidity Index (THI)", calculated based on changes in environmental temperature and air humidity, and "Heat Resistance" measured according to the Benezra and Rhoad coefficients. The calculation of heat resistance is based on physiological characteristics (body temperature, heart rate, and respiratory rate). Data was collected twice a day, in the morning and afternoon, on 40 BX cattles. The results of the morning and the afternoon research showed that the average THI was respectively 75.5 $\pm$ 2.03 and 82.68 $\pm$ 1.06, the average body temperature was 37.79 $\pm$ 0.27 and 38.28 $\pm$ 0.29 degrees Celsius, the respiratory rate was 19.04 $\pm$ 1.87 and 25.68 $\pm$ 1.33 breaths per minute, the heart rate was 52.80 $\pm$ 6.09 and 59 $\pm$ 5.96 beats per minute, heat resistance Based on the Benezra and Rhoad coefficients, they were 2.35 $\pm$ 0.28 and 96.40 $\pm$ 1.52. The conclusion is that BX cattles kept at the UPT Aia Pacah, Padang is in moderate stress conditions during the day, while the heat resistance of 2.35 is slightly above the normal value of 2 and the Road coefficient is 96.04.

Key words: Brahman Cross (BX), Temperature Humidity Index (THI) and Heat Tolerance.

INTRODUCTION

Various government efforts to increase the beef cattle population have been carried out both quantitatively and qualitatively, including artificial insemination and embryo transfer (Syafrizal and Henri, 2021) and by bringing in crossbred cattle. Raising crossbred cattle is the most optimal alternative in the beef cattle production system in Indonesia (Widi, 2015). One type of crossbred cattle introduced by the government is the Brahman cross cattle imported from Australia. According to Hadi and Ilham (2002), the Brahman cross is a cross between Brahman cattle of Bos indicus descent and European cattle of the Bos Taurus group. The results of crossbreeding from various breeds make the Brahman cross cattle have high production performance and can adapt to tropical climates, especially in Indonesia. This type of cattle was imported to West Sumatra, especially to the city of Padang from Australia

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via the province of Lampung. Padang is a city located on the west coast of Sumatra with a relatively hot temperature ranging from 22.5 - 34^{o}C, relative humidity of 79-90% (BPS Padang City, 2024). Temperature and humidity greatly affect the physiological conditions of livestock which can result in decreased production and reproduction capacity. Triwulanningsih et al., (2009) stated that reproductive failure or failure to achieve optimal reproductive efficiency as mentioned above is the result of environmental, hormonal, genetic, and disease factors. Environmental changes such as increased temperature, humidity, wind speed, and sun intensity can affect the physiological response of livestock because livestock integrates environmental conditions and then respond adaptively through physiological changes including changes in body temperature, heart rate, and increased respiration rate (Atrian and Syahryar, 2012). In addition, livestock will respond with further responses in the form of changes in the hormonal, enzymatic, and metabolic systems which can cause livestock to experience various symptoms of disease accompanied by low production and reproduction efficiency (Nuryasa et al., 2016). This research was conducted at the Padang City Beef Cattle Breeding UPT to determine the heat resistance of Brahman cross cattle in Padang City.

Environmental factors like increased temperature, humidity, wind speed, and sun intensity can impact livestock's physiological responses, as animals adapt to environmental conditions by adjusting body temperature, heart rate, and respiration rate (Atrian and Syahryar, 2012). Additionally, livestock may exhibit further adaptation in hormonal, enzymatic and metabolic systems, potentially leading to disease symptoms and reduce production and reproduction efficiency (Nuryasa, et al., 2016). This study took place at cattle breeding UPT in Padang City to asses the heat tolerance of Brahman cross.

METHODOLOGY

The study was conducted using a descriptive method from March 4 to April 8, 2024, at the Aia Pacah beef cattle breeding UPT, Padang City, West Sumatra. The research material was 40 female BX cattle aged 3 to 5 years determined based on the exchange and sharpening of the incisors. The equipment used was a stethoscope to measure the heart rate, by attaching the stethoscope to the exterior chest of the cranial body Axis line of the diaphragm which was counted for one minute. A stopwatch and hand counter were used to record The respiratory rate by holding the back of the hand close to the cow's nose to feel and count each breath over one minute. Ambient temperature and relative humidity were measured using a thermos-hygrometer, while a clinical thermometer was used to measure body temperature by placing it in the cow's rectum until a stable reading was achieved. These measurements were taken twice daily, in the morning between 7.00 to 9.00 am and from 12.00 to 2.00 pm. The Temperature Humidity Index (THI) was then calculated according to the formula by Bullita et al., (2015

THI = Tab + RH(Tab-14.4) +46.4
Description:

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THI = Temperature Humidity Index
Tab = Temperature Absolut

Heat resistance (DTP) is calculated with the Benezra and Rhoad coefficients with the formula modified by Suharsono (2008)

$$DTP = \frac{RT1}{RT0} + \frac{NR1}{NR0}$$

Description:

DTP = Heat Endurance
RT1 = Daytime Body Temperature
RT0 = Morning Body Temperature
NR1 = Daytime Respiration Frequency
NR0 = Morning Respiration Frequency

and Rhoad coefficient with the formula HTC = 100 - 10 (BT1 - BT0)
Description:
HTC = Heat Tolerance Coefficient
BT1 = Daytime Body Temperature
BT0 = Morning Body Temperature

RESULT AND DISCUSSION

Geographic of Padang

Brahman Cross (BX) cattle imported to Padang City from Australia via Lampung Province are crossbred Brahman and European cattle (Bos Taurus). According to Yulianto and Saparinto (2010), Brahman Cross cattle were originally developed in Australia as a cross between Hereford-Shorthorn (HS) and Gestrudies and this type of cattle is widely raised and bred in South Lampung. The main objective of this crossbreeding is to create a breed of tropical/subtropical beef cattle that has high productivity and is resistant to high temperatures.

The average ambient temperature, air humidity, and Humidity Index Temperature of Padang City are as in Table 1 below:

Table. 1. Environmental Temperature, Air Humidity and THI in the Research Area

	Morning	Afternoon
Ambient Temp (°C)	25.40 ± 1.14[a]	30.60 ± 0.89[b]
Humidity (%)	73.80 ± 0.03[a]	66.60 ± 2.07[b]
THI	75.50 + 2.03[a]	82.68 + 1.06[b]

The average ambient temperature of the morning measurement results was 25.40 + 1.14°C and during the day 30.60 + 0.89. The comparison test (t-test) showed that there was a significant difference (P <0.05) between the morning and afternoon temperatures as well as the average air humidity in the morning was 73.80 + 0.03°C and during the day 66.60 + 2.07°C. According to the BPS of Padang City (2024) states that the air temperature of Padang City ranges from 22 - 31.7oC. This temperature range is still within the ideal ambient temperature range for cattle according to the opinion and statement of Das et al (2016) which states that the ideal ambient temperature for cattle in tropical areas should not be more than 27°C if the cattle are in an environment above 27 oC then the cattle will be in an uncomfortable zone which is characterized by

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an increase in the respiratory rate, heart rate and body temperature. This causes the cow to maintain its respiratory rate, heart rate and body temperature with a thermoregulation system. Furthermore, Polsky and Von Keyserlingk (2017) stated that the safe zone for Bos indicus cattle is at a temperature of 16 - 27^{o}C.

Temperature Humidity Index (THI)

The average Temperature Humidity Index at the research location was 82.68. Various factors can influence this number, such as environmental temperature and air humidity differences. The combined effect of these two factors greatly affects the level of heat stress in livestock. Gebremedhin et al (2008) stated that beef cattle can grow optimally in areas with temperatures ranging from 10 to 28^{o}C with humidity of 60-85%. The Temperature Humidity Index value at this research location when compared with the standards issued by Beef Quality Assurance (2014) by the University of Nebraska-Lincoln, namely the Temperature Humidity Index with a range of 79-83, cattle are suspected of experiencing moderate stress (Danger Zone). Based on this standard, the condition of the cattle kept in this UPT is in a critical condition approaching severe stress. Bullita et al (2015) also stated that if the Temperature Humidity Index value is below ≤74 is normal, 75-78 mild stress, 79-83 moderate stress, and ≥84 then the cattle are in a condition of severe stress, however, the way heat is released by the cattle also depends on the availability of water, the surface area of evaporation and the degree of airflow or wind speed.

Body temperature

Body temperature is one manifestation of livestock response to changes in environmental temperature and air humidity. The average body temperature, respiratory frequency, and heart rate of Brahman Cross cattle in the morning and afternoon are shown in the following Table 2:

Table. 2. Physiological Response and Heat Resistance of BX Cattle

Physiological Response	Morning	Afternoon
Body Temperature (^{o}C)	37.79 ± 0.27	38.28 ± 0.29
Respiration Rate (breaths/min)	19.00 ± 1.87	25.68 ± 1.33
Heart Rate (beat/min)	52.80 ± 6.09	59.00 ± 5.96
Heat Tolerance		
Benezra Coefficient	2.35 ± 0.28	
Rhoad Coefficient	96.40 ± 1.52	

In the research area, the average body temperature of cattle in the morning was 37.79 + 0.27^{o}C. The body temperature of Brahman Cross cattle is still influenced by the low environmental temperature of 25.40 + 1.14^{o}C (table 1), in addition, the humidity in the

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morning is still quite adequate at 73.80 + 0.03ºC (table 1) so that the cattle are still in comfortable conditions according to the opinion of Yousef (1985) that the Comfort zone for cattle in tropical areas ranges from 22 - 30ºC. Body temperature during the day increases to 38.28 + 0.29ºC. This increase in body temperature occurs along with the increase in environmental temperature and air humidity which tends to decrease. Sjaastad et al (2003) stated that in thermoneutral conditions the core body temperature of cattle is between 38 - 38.5ºC. In addition, according to Frans *et al* (2020), an increase in body temperature can also occur due to physical activity. Added by Abduh *et al* (2022) that increased body temperature can result in physiological disorders, further stated by Indrawati and Utami (2022) that rectal temperature in livestock can be influenced by environmental temperature, feeding, drinking, and digestion activities, and heat production by the body indirectly depends on the food it obtains and the amount of food supply in the digestive tract. In addition to environmental factors, animal genotype is also a major factor that influences tropical heat tolerance. Lees *et al* (2019) stated that genetics contribute to its susceptibility or tolerance to heat loads. Previously, Gaughan (2010) stated that identifying heat-tolerant cattle is not a new concept because many breeds are already known for their thermal tolerance.

Respiratory Rate

The physiological response of livestock to heat loads from the environment includes respiratory rate and breaths per minute Gaughan (2000). The average respiratory frequency in this study in the morning and afternoon were 19 $\pm$ 1.87 and 25.68 $\pm$ 1.33 breaths per minute, respectively. This result is higher compared to Jackson and Cockroft (2002) that the normal respiration rate in adult cattle is 15 to 35 breaths per minute but lower compared to the research of Aditya *et al*., (2022) on the respiratory rate of Brahman cross cattle, which is 34.47 $\pm$ 5.20 times per minute during the day. This difference is caused by differences in time and place of research which result in differences in environmental conditions such as temperature, humidity, wind, rainfall and so on. The combination of these environmental influences has an effect on the respiratory rate of cattle.

Heart rate

The heart rate in the morning ranges from 42-58 with an average of 52.80 beats per minute and during the day ranges from 46 to 68 with an average of 57.44 beats per minute (table 2). This condition is still normal when compared to Kubkomawa (2015) study which stated that the heart rate of cattle in normal conditions in tropical areas ranges from 40 to 70 beats per minute. This average is also lower than the results of Aditya *et al*., (2022) study on Brahman cross cattle at KPT Maju Sejahtera Tanjungsari, South Lampung, that the respiratory rate was 59.28 in the morning and 76.19 beats per minute during the day. This can be understood because of the difference in environmental temperature and humidity between Lampung and Padang City.

Heat Resistance (DTP)

Heat resistance is calculated based on body temperature and respiratory rate in the morning and afternoon. According to Qisthon and Hartono (2019), the heat tolerance coefficient is a value used to determine the ability of livestock to adapt to hot conditions or

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heat resistance in an area. By the opinion of Amakiri and Fusho (2011) that body temperature and respiratory rate are responses from livestock experiencing heat stress. In this study, heat resistance is explained by the Benezra and Rhoad coefficients which show values of 2.35 + 0.28 and 96.40 + 1.52, respectively. This figure is lower than Aditya (2022) study which stated that the heat resistance of Brahman Cross cattle in KPT Maju Sejahtera was 2.67 + 0.24. Livestock can be said to have a good level of heat resistance if the DTP value is = 2. The higher the value, the lower the level of heat resistance. This is due to the faster the respiratory rate and body temperature increase, thus the higher the DTP value. Arifin *et al*., (2012) explained that for livestock that have a good level of heat resistance if the HTC value is = 2, the higher the HTC value means the lower the level of heat resistance of the livestock. Furthermore, the HTC value based on the Rhoad Coefficient in the study area shows the figure 96.40 + 1.52. Fajar and Isroli's (2015) opinion states that the normal HTC value according to Rhoad is 100, where the higher the value, the better.

CONCLUSION

Brahman cross cattle raised at the UPT breeding Aia Pacah in Padang City have heat resistance based on the Benezra and Rhoad coefficients approaching 2 and 100, namely 2.35 and 96.40 respectively. This shows that Brahman Cross cattle still have a fairly good heat resistance value and are suitable for development in Padang City with an environmental temperature ranging from 25-31^{o}C and humidity of 66-74%.

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