

Adaptive Ability of Limousine-Madura Crossed Cattle Compare with Madura Cattle at Madura Island

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ABSTRACT

Research on measurement of heat tolerance was done at Madura Island. The research aimed to compare adaptive ability based on heat tolerance in Local cattle in Madura (Madura cattle) and Limousine-Madura crossed cattle. The materials used in this research were 80 Madura cattle consisting of 20 Madura bull, 20 Madura cows, 20 Limousine-Madura crossed bulls (crosses between Limousin bull and Madura cow) and 20 Limousine-Madura crossed cow. Measurement of heat tolerance using the Benezra coefficient with the parameter of respiration rate and rectal temperature. The data obtained were analyzed using Analysis of Variance with Two Way Classification model without interaction and assisted by the Minitab software version 13.1. Result showed that the average value of heat tolerance using Benezra coefficient each of Madura bull 2.23, Madura cow 2.24, Limousine-Madura crossed bull 2.24 and Limousine-Madura crossed cow 2.21. 1 Data analysis also showed that there were no significant differences in HTC of Madura cattle and Limousine-Madura crossed cattle both in male and female. Based on the heat tolerance, Limousine-Madura crossed cattle suitable to be developed in the Madura Island. So, we can conclude the heat tolerance coefficient Madura cattle and Limousine-Madura crossed cattle approaching optimal heat tolerance coefficient namely 2, it means that Limousine-Madura crossed cattle suitable to be developed in Madura Island.

Keywords: Heat tolerance coefficient, HTC, Respiration rate, Rectal temperature

BACKGROUND

One of the local Indonesian cows is Madura cattle on the island of Madura. Madura cattle are one of the beef cattle germplasm that lives in habitats in dry and infertile environments. This cow has good adaptability to heat stress, poor feed and small body with good reproductive ability. As other beef cattle show a decrease in productivity which can be caused by negative selection namely productive cattle slaughter and inbreeding factors due to the Madurese Government banning other beef cattle from entering Madura Island. One effort to increase the income and welfare of the community through beef cattle commodities is by increasing the productivity of these cows by avoiding the negative factors mentioned above.

Madura cow is one of the local Indonesian cattle which are suspected of crossing Zebu cattle (*Bos indicus*) and bulls (*Bos javanicus*). Madura cattle can be grouped into 3 uses, namely Karapan cattle (race), Sonok cattle and Broiler cattle [1]. Madura cattle are now a local beef cattle breed formed as a result of natural isolation and environmental influences, so that they have uniform characteristics that stand out among other local beef cattle breeds in Indonesia. Zebu cattle have contributed genetic traits such as tolerance to stress due to climate, resistance to tick attacks and strict

natural and environmental selection in a long period of time, so Madura cattle become cattle nation which has very high adaptability to the environment. Madura cattle have a good response to the improvement of feed and resistance to feed with high crude fiber content [2].

Local cattle have better durability and better reproductive ability than cross bred. Crossbred cows in Madura have genes from the *Bos Taurus* nation which are known to be not resistant to hot environments but have good and fast body weight growth. Local livestock are more adaptable to environmental conditions and maintenance management conditions in Indonesia, most of which are maintained on people's farms [3] revealed that people's livestock on the island of Madura used two types of cattle, namely Madura cattle and Limousine-Madura crossed cattle (in Indonesia

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called Madrasin cattle). New cross cows between Madurese cattle and Limousin cattle entered the island of Madura around 2000. The introduction of Limousine cattle entered the island of Madura through Artificial Insemination (AI). Crossbreeding between Madurese cattle and Limousin cattle to improve genetic quality and productivity of local cattle. Limousine-Madura crossed cattle have an exterior body appearance and body weight better than Madura cattle [4]. Madura cattle cross with Limousin to increase life weight. This effort was slowly applied by farmers supported by the Government, especially when decentralization policies were implemented in Indonesia. The Regional Government of Madura Island tries to introduce cross-livestock to increase farmers' income, but this will conflict with the efforts of national policies to preserve Madurese cattle as indigenous genetic resources. The results of crossing will eliminate the original characteristics of Madura cattle [5] revealed that Madura farmers felt that Limousin cattle crossed with Madura (Limad or Limousine-Madura crossed) increased weight and were more profitable than Madura cattle.

Air temperature increases above the thermonetral temperature so the cow will experience stress. How to find out the cattle experiencing stress can be done by knowing the body temperature passes the measurement results of rectal temperature, respiration rate, and heat tolerance coefficient calculations. According to Tyler and Enseminger [6] which states that the resistance of livestock in the tropics to heat is one of the most important factors so that livestock produce optimally according to their genetic abilities. Livestock that are not heat resistant, their productivity will decrease due to reduced feed consumption. Meanwhile livestock that are resistant to heat can maintain their body temperature within the normal range without experiencing changes in physiological status and productivity.

MATERIALS AND METHOD

Research was conducted at Sumenep district in Madura Regency starting on January 25-February 20, 2017. The research materials used were 80 Madura cattle consisting of 20 Madura bulls, 20 Madura cows, 20 Limousine-Madura crossed bulls and 20 Limousine-Madura crossed cows, age range 1.5 to 2 years. This study distinguished between male and female to determine the physiological conditions of the animals. Measured variables were temperature and humidity to determine temperature and humidity at maximum conditions, temperature of rectal using thermometer that is

inserted into the rectum for about 1 min. Body temperature is measured when the animal is inactive (in a calm state), respiration rate is calculated using the hand tally counter by observing the number of breaths in the cow for 1 minute placed in the trachea, respiration rate and body temperature of beef cattle as variables for HTC (Heat Tolerance Coefficients) calculation using the Benezra formula [7].

$$HTC = TB/38.3 + Fr/23$$

Whereas, HTC: Heat Tolerance Coefficient; Tb: Average of Body Temperature (°C); Fr: Average of Respiration Rate for about 1 min; 38.3: Standard Number of Body Temperature; 23: Standard Number of Respiration Rate of Cattle for 1 min

The data obtained were analyzed using Analysis of Variance with Two Way Classification model without interaction, and assisted by the Minitab software version 13.1.

Mathematical Model:

$$Y_{ijk} = \mu + A_i + B_j + e_{ijk}$$

Whereas, Y_{ijk} : Observations (HTC) on the i^{th} breed of cattle, j^{th} sex of cattle (female/male) and k^{th} replications; μ : General Population Mean; A_i : Effect of i^{th} level of cattle breed (Madura/Limousine-Madura crossed cattle); B_j : Effect of j^{th} level of sex of cattle (male/ female); e_{ijk} : Effect of error at i -level of factor A, factor B at level j^{th} and k^{th} replications

RESULTS AND DISCUSSION

Overview of research location

This research was conducted at Sumenep Regency, Madura Island and East Java Province. Lenteng sub-district is one of 27 sub-districts in Sumenep Regency. The distance from Sumenep City to Lenteng District is ± 10 km. The geographic location is in the east of Pamekasan Regency. It is one of the sites of the Government of Sumenep Regency; Lenteng is included in the highlands and lowlands which comprise most of the land and rice fields. This location was placed at an altitude less than 500 m above sea level and including the lowland area, it has an area of 7,140.58 hectares. According to the Topography, 84.18% of Lenteng Subdistrict or 60.11 km² has a land slope between 30 to 60% or is a hilly area, approximately 15.82% of the total area or around 11.29 km² is a sloping area. The types of land in Lenteng Sub-District include: Alluvial, Litosol, Mediterranean Kemerah Merah, Grumosol and Regosol [8] (Table 1).

Table 1. The average of climatic condition at the location of the research.

Climatic factors	Unit	The averages
Temperature	°C	32
Relative humidity	%	79

Source: Result of survey at January 2017

At the time when the research was done, rainfall in Sumenep district was higher than the average rainfall in previous years, with a temperature of 32°C and humidity reaching 79% in January. Kutsiyah [2] stated that Madura Island is a hot and dry area with a temperature of 27-34°C, rainfall of 1600 mm/year, humidity of 80% and dry soil conditions.

Physiological response of the animals

Madura cattle are local beef cattle which have ability to adapt to the tropical environment and poor quality of feed. The response of cows experiencing heat stress can be seen from the measurement of rectal temperature and respiration

rate. Purwanto et al. [9] revealed that many factors that affect livestock experience heat stress, namely temperature and humidity, feed, physiological conditions of livestock can be measured by respiratory rate and rectal temperature. Factors that affect the physiology of livestock are temperature, humidity, feed consumption, age, muscle activity, pregnancy and stress. Body temperature and respiration rate are parameters used to predict the adaptability of livestock to stress that occurs in the body. Average rectal temperature, respiration rate, HTC in Madura cattle and Limousine-Madura crossed cattle are described in **Table 2**.

Table 2. Heat tolerance coefficient (HTC) of Madura and Limousine-Madura crossed cattle in male and female.

	Madura cattle	Limousine-Madura crossed cattle
Female	2.2 ± 0.09	2.2 ± 0.10
Male	2.2 ± 0.08	2.2 ± 0.15

From analysis of variance, it was showed that there is no significant difference between two breed of cattle, both in female and male. With the same of HTC, that means the adaptability of two cattle was almost the same, although the two breed cattle have different origin.

Temperature and air humidity have a direct effect on the physiological changes of cattle, so that it will ultimately have an impact on production. In conditions of high temperature and humidity there will be a determination between the balance of the process of heat gain (metabolic heat production and the acquisition of the environment) by removing heat in order to maintain normal body temperature levels. The higher the ambient temperature above the *thermoneutral zone* will cause more heat gain than the release of heat, as a result of an increase in body temperature [10]. When body temperature rises, livestock efforts will occur to release heat which results in increased consumption of drinking water and reduced feed consumption and energy used to regulate body temperature increases. Increased body temperature will increase the metabolic rate.

Rectal temperature of Madura cattle and Limousine-Madura crossed cattle

Observation of physiological responses of cattle in Madura cattle and Limousine-Madura crossed cattle by measuring the rectal temperature was using a thermometer on the cattle rectum for 1 min. An observation on the rectal temperature of animals in Madura cattle and Limousine-Madura crossed cattle is carried out at 09.00-14.00. The observation of rectal temperature is shown in **Table 2**. The rectal temperature in bulls is higher compared to female cattle, but the difference is not significant. Based on the data in **Table 2** shows that the adaptability of the Limousine-Madura crossed cattle maintained on the island of Madura is quite good (respiration rate, rectal temperature and HTC are quite optimal).

It is suspected that cows are able to carry out the thermoregulation process through the mechanism of homeostasis in the body. If you experience body heat stress, the cow will make changes in rectal temperature. This is in accordance with the opinion of Naiddin et al. [11] which states that respond on environment temperature is regulated by the thermoregulatory mechanisms and play important roles in maintaining physiological homeostasis during rest and physical exercise. Physical exertion poses a challenge to thermoregulation by causing a substantial increase in metabolic heat production.

Respiration rate Madurese and Limousine-Madurese cows crossed

Respiration is the process of taking air which is inserted in the lungs through the nose and trachea, then returned regularly. The purpose of respiration is to maximize heat expenditure because livestock are at high temperatures and humidity. Determination of respiration rate is calculated by feeling the breath of air breathing in and out through the nose. Calculation of respiration rate in cattle is done by counting the breath for 1 min with HTC (Hand Tally Counter). Determination of the frequency of respiration is sought when the animals are calm. Jackson and Cockroft [12] which states that breathing frequency (times/min), measured by placing the back of the palm of the hand on a cow's nose through a calculation of breath or short breath for 1 min is assisted by observing the rise and fall of the rib section of the chest. Normal respiration in adult cattle is 15-35 times/min and 20-40 times/min on calves.

Based on the results obtained by the respiration rate average of cattle in male Madura cattle 28.4 ± 1.6 times/min, female Madura 28.4 ± 1.8 times/min, Limousine-Madura crossed male 28.8 ± 3.2 times/min and Limousine-Madura crossed females 28.0 ± 2.7 times/min. Differences in respiration rate

between Madurese cattle and respiration rate Madurese and Limousine-Madurese cows crossed.

Limousine-Madura crossed cattle the results were not too far apart from the sex differences that were nested in the nation so it did not give a significant difference ($P > 0.05$). The results of the analysis of the data obtained indicate that the respiration rate in Madura cattle and Limousine-Madura cattle is crossed on average 28 times/min. According to Rensis and Scaramuzzi [13] who say that the respiration rate in adult cows ranges from 12-16 times every minute, while in young cattle between 27-37 times/min.

Madura cattle and Limousine-Madura crossed cattle in the Sumenep area were fed with elephant grass, field grass and leaves in the rainy season, while in the dry season the cows were fed with agricultural waste or dry straw. The maintenance system relies on makeshift feed sources available in the local area. Farmers do not provide concentrated feed because it is difficult to obtain and prices that are considered quite expensive make farmers choose to provide green grass and dry straw. According to Ghiardien et al. [14] which states that the availability of feed sources is one of the obstacles that hinder the development of quantity of cattle production in Indonesia. Various efforts began to be made, namely increasing the use of forage land with multilevel systems, utilization of agricultural waste as a source of forage and the provision of other alternative feeds that could overcome the availability of feed.

Heat tolerance coefficient (HTC) in Madura cattle and Limousine-Madura crossed cattle

The HTC value is one way of measuring that can be done to find out whether an animal has stress or not. Calculation results regarding the heat resistance of Madura cattle and Limousine-Madura crossed cattle were calculated using the Benezra coefficient formula and Nested formula. The parameters observed for calculating HTC are rectal temperature and respiration rate in these animals. Body temperature and respiration rate are basic parameters used to predict the adaptability of livestock. Increase in body temperature and respiration rate is proportional to the increase in HTC (Heat Tolerance Coefficient) [15]. Respiratory rate increases when body temperature increases so that HTC will also increase. Livestock are said not to be subjected to heat stress if the HTC value is not more than 2 and not less than 2. The higher the value of HTC indicates that the livestock has a low resistance. The temperature in the animal's body will return to normal if heat can be released through breathing and perspiration. The greater the increase in rectal temperature and respiration rate, the higher the HTC value produced states that heat stress in livestock causes livestock to experience physiological function disorders and decreased immunity [16,17].

Table 2 shows HTC in male Madura cattle 2.2 ± 0.08 , female Madura cattle 2.2 ± 0.09 , Limousine-Madura crossed

cattle male 2.2 ± 0.15 and Limousine-Madura crossed cattle with female 2.2 ± 0.10 this shows that the average HTC in Madura cattle and Limousine-Madura crossed cattle that occur during the day has an HTC value above 2, meaning that the cow is experiencing stress. The difference is not far adrift so that it can be said that the adaptation of Madura cattle and Limousine-Madura cattle is crossed quite well with hot temperatures. According to Serang et al. [18] which revealed that HTC's value of more than 2 could be said that the livestock was subjected to heat stress due to feed factors and livestock inconvenience at the time of their cage and environment. Environmental conditions in the hot area like Sumenep can cause livestock to get heat stress at body temperature and will have an impact on increasing rectal temperature, respiration rate, decreased appetite; livestock will consume a lot of water to reduce the heat that is present in the body so that it will have an impact on reducing livestock production. The model of determining the physical temperature based on the physiological response of cattle is quite intensive in the subtropical regions. Determination of critical temperature based on the physiological response of cattle kept in the lowlands in people's livestock business is still not done thoroughly. This is in accordance with the views of Kamanga-Sollo et al. [19], which explain that when an animal's body experiences heat stress, the body will reduce the rate of metabolism by suppressing the secretion of the thyroxine hormone and releasing heat shock proteins that have an important role in respond to heat stress and other types of cellular stress and in the level of regulation and efficiency of muscle development. Yani and Purwanto [20] added that ongoing heat stress in livestock will have an impact on increasing drinking water consumption, increasing urine volume and decreasing feed consumption.

CONCLUSION

In this research, Madura cattle and Limousine-Madura crossed cattle raised in the same hot environments. The average HTC the day is 2.2, the respiration rate is 28 times/min and the rectal temperature is 38°C so it can be said that the Limousine-Madura crossed cattle does not suffer from heat stress and is suitable for development in Madura. It was very important to control on management to maintain cattle, especially Limouse-Madura crossed condition and protected the livestock from temperature and feed stress.

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