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Physiological Response of Broiler Chicken To Cage Temperature

[a]Dody Karnovel, *Jhon Hendri, dan Alfian Asri,

[a]Department of Animal Science, Faculty of Agriculture, University of Mahaputra Muhammad Yamin, Solok. Indonesia.

Correspondence e-mail: johnhendri194@gmail.com

Departemen animal science, Faculty of Agriculture. University of Mahaputra Muhammad Yamin, Solok .

ABSTRACT

This study aims to study the physiological response shown by broiler chickens to cage temperatures at different times. A completely randomised design was used in this research, with three treatments and five replications of each. The treatments were the average temperature of the cage in the afternoon (30.15^{o}C) , afternoon (27.04^{o}C), and morning (26.01 °C). Each treatment was repeated six times, and each replication consisted of 5 chickens. The variables measured in this study are respiratory rate, heart rate, and rectal temperature in broiler chickens. If the results of the analysis of variance show that there is a significant difference between treatments, it is continued with the Duncan Multiple Range test. The results showed that the temperature of the cage during the day significantly increased the frequency of breathing of broiler chickens (74.90 times/minute), heart rate (279.50 times/minute), and rectal temperature (41.53 ^{o}C) compared to the frequency of breathing (57 times). ,27 times/minute and 55.77 times/minute), heart rate (274.07 times/minute and 272.47 times/minute), and rectal temperature (40.74^{o}C and 40.61^{o}C) In the afternoon and the morning, it can be concluded that the temperature of the cage during the day resulted in the frequency of breathing, heart rate and rectal temperature in broilers which were significantly higher than the temperature of the cell in the afternoon and morning, while the temperature of the cell in In the afternoon, the respiratory frequency, heart rate, and rectal temperature were not significantly higher than the cage temperature in the morning.

Keywords: physiological response, broiler, respiratory rate, heart rate, rectal temperature

INTRODUCTION

One environmental factor that plays a significant role in the appearance of broilers, especially reared in the tropics, is the ambient temperature. 13-27 ^{o}C. The average daytime temperature in the tropics is 29.8-36.9^{o}C and 12.424, respectively. 2" C at night. This, according to Sulistyoningsih (2004), shows that temperature fluctuations are very real between day and night so the environmental temperature greatly affects the appearance of broiler chickens. Qumiawan et al. (2016) stated that temperature directly affects comfort, physiological processes, and livestock productivity .Chickens are warm-blooded (homeothermic) animals that can maintain their internal body temperature (homeostasis). This mechanism is only effective at a certain temperature limit so that

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at extreme temperatures, chickens can no longer adapt well. High environmental temperatures will affect the behavior of livestock and the functions of several organs, such as the heart and respiratory organs, and indirectly affect the increase in the hormones corticosterone and cortisol and the decrease in the hormones adrenaline and thyroxine in the blood (Sohailet al., 2010). Mulyantini (2010), birds have a layer of subcutaneous fat that functions as an insulator. This biological condition, according to Ewing et al., (1999) in Tamzil (2014), causes poultry in high temperatures to have difficulty dissipating body heat into the environment. Layers of fat and feathers help retain body heat, while the absence of sweat glands means that the method of releasing excess heat in birds is limited, unlike the evaporation of sweat from the skin. Heat stress has a significant effect on the physiology of chickens, especially after chickens are more than three weeks old, because at that age the body covering hair is complete Broilers aged over 3 weeks that get an ambient temperature above 32^{o}C will experience serious heat stress. If broilers get heat stress, it will reduce feed consumption and increase drinking water consumption so that the formation of endothermic body heat can be reduced (Cooper and Washburn 1998 in Tamzil, 2014). The internal condition of the bird's body can be known by measuring the frequency of respiration, heart rate, and rectal temperature (Hapsari et al., 2016). All of these things are part of the physiological response that is shown directly due to environmental temperature (Qurniawan et al., 2016). Frandson (1992) states that the normal range of respiratory frequency, heart rate, and rectal temperature of broilers is 18-23 times/minute, 250--470 times/minute, and 40.6--43.^{0} C. Environmental factors, especially cage temperature, greatly affect physiological responses in addition to activity, body weight, and energy content of the feed. High physiological responses will cause growth disturbances and can even cause death (Hapsari et al., 2016). Decreased production (growth and egg production), according to Tabiri et al., (2000) in Tamzil (2014), is caused by reduced nitrogen retention and continues to decrease the digestibility of protein and some amino acids, increased excretion of some minerals in the urine (Belay et al. al., 1992 in Kusnadi, 2007), as well as the decrease in useful bacteria in the digestive tract. Poultry suffering from stress will experience panting

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with a frequency directly proportional to the level of stress, increased rectal temperature, and increased levels of the hormone corticosterone (Tamzil et al., 2013). High corticosterone concentrations in chicken blood will affect several things: increased heart rate, increased blood pressure, decreased appetite, decreased antibodies produced, and low average daily body weight (Fadilah, 2013). The activity of these two hormones will decrease when the ambient temperature is high. Santoso (2009) argues that homeothermic animals have a stable body temperature and are not influenced by the environment. Homeostasis is maintained by physiological mechanisms, most of which are controlled by the nervous and endocrine systems. When the ambient temperature is high, the broiler will activate the nervous system and hormones so that homeostasis in the body is maintained and the broiler's physiological system can work. The hormonal system in the body is controlled by the hypothalamus. The hypothalamus will secrete hormones to stabilize broiler'siler body temperature. So far, it is not known exactly to what extent fluctuations in cage temperature at different times of the day, afternoon, and morning can be tolerated by the internal conditions of broiler chickens as indicated by their physiological responses in the form of Qumiawan et al., (2016), stated that the physiological response is a parameter that aims to determine the level of stress received by broilers during rearing. Physiological status is related to microclimatic conditions in the cage. Microclimatics are microclimatic conditions that occur in the cage, including temperature.

METHODS

Research Material

The breed used was broiler CP 707 strain aged 22 to 27 the day the results of the breeding of PT Charoen Pokphand Indonesia as many as five tails, which were not distinguished by sex (unisex). The feed is commercial with the brand 511 Bravo, produced by PT Charoen Pokphand. The cage used is a stage system cage with 1 unit of slat floor. The tools used are six manual feed and drink containers with a capacity of 8 kg and 10 liters, a stethoscope, body thermometer, room thermometer, rope

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counter, digital hygrothermo, stopwatch, and digital camera.

Research methods

The design used was a Completely Randomized Design (CRD), with three treatments, namely the average temperature of the cage in the afternoon (30.15 ^{o}C), afternoon (27.04 ^{o}C), and morning (26.01^{o}C). Each treatment was repeated for six days, and each replication consisted of 5 chickens.

Parameters Measured in the implementation of this research are:

1. Breathing Frequency. Measured by calculating the movement of the thorax (chest) for 60 seconds.
2. Heart Rate Frequency. It is measured by placing a stethoscope on the left chest of the broiler so that the heart rate is heard and counted for 60 seconds.
3. Rectal Temperature. It was measured by inserting a body thermometer into the broiler's rectum (anus) as deep as ± 2 cm and seeing the temperature.

Research Procedures

A total of 5 broiler chickens are kept in 1 unit of litter cage feed and drink were carried out ad libitum (available continuously). Measurement of the observed variables was carried out starting at 22 days of age. Measurements were carried out always for six days, each of which was divided into 3 times, namely afternoon, evening, and morning. Measurements for the time of day are carried out at 12.00 - 13.00 WIB, in the afternoon at 17.00-18.00 WIB, and in the morning at 07.00-08.00 WIB. Each measurement at different times was carried out on 5 chickens. Also, measurements were made on the temperature of the cage, and the average was sought for each time of observation.

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RESULTS AND DISCUSSION

The effect of cage temperature at different times on respiratory frequency, heart rate, and rectal temperature in broiler chickens can be seen in Table 1 below.

Table 1. Effect of cage temperature at different times on respiratory frequency, heart rate, and rectal temperature in broilers

Cage temperature (ºC)	Respiratory rate (times/minute)	Heart rate (times/minute)	Rectal temperature (ºC)
Afternoon (30,15)	74,90 [a]	279,50 [a]	41,53 [a]
Afternoon (27,04)	57,27 [b]	274,07 [b]	40,74 [b]
Morning (26,01)	55,77 [b]	272,47 [b]	40,61 [b]

Note: different letters in the same column indicate a very significant difference (P<0.01)

Respiratory Frequency in Broiler Chickens

The data in Table 1 shows that the temperature of the cage at different times shows a very significant effect (P<0.01) on respiratory frequency in broilers. Increasing environmental (cage) temperature increases respiratory frequency. The increase in respiratory activity as a result of environmental temperature, according to Adriani et al., (2011), is an effort to maintain body temperature at a normal level. In this case, the only organ that can carry out the evaporation process effectively is the respiratory system. The future by Duncan Multiple Distance tests showed that the cage temperature during the day (30,15 ºC) significantly increased respiratory frequency compared to the cage temperature in the afternoon (27,04oC) and morning (26,01 ºC). This is because the highest temperature in the cage during the day is 30.15 ºC, which is a temperature above the comfort zone for broilers, so they suffer from heat, and physiological changes occur in the form of increased respiratory frequency, while the temperature in the afternoon and morning is the temperature range which is still as needed (tolerable) so that the broiler has not been affected by heat and the respiratory frequency is still normal. Rosidi et al., (1999), stated that the comfort zone for broilers is 13–27 ºC; 26–27 ºC for adult chickens.

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At high temperatures, chickens experience hormonal imbalance as indicated by an increase in body temperature, muscle contractions, accelerated respiratory frequency, and begin to experience stress. Chickens adapt by trying to lower their body temperature. The process of releasing body heat to the environment through radiation, conduction, and convection is inadequate, the chicken will change the pattern of releasing heat through the process of evaporation of water from the respiratory tract. The physical activity shown by chickens is by opening their beaks and breathing rapidly (an increase in respiratory frequency) also called panting. Cooper and Wahsburn (1988), stated that if rearing is carried out above a comfortable temperature range, livestock will suffer stress because they have difficulty dissipating their body heat into the environment. As the respiratory frequency increases, the heat released also increases. The heat released through respiration in animals is much greater, meaning it is through the evaporation of air from sweat glands, especially in birds that do not have sweat glands (Adriani et al., 2011). The results of this study are by Fransisco's statement (2018), that the panting behavior of broiler chickens > 3 weeks old during the day (cage temperature 30.32 ^{o}C) is very significantly increased (44.59%) compared to the panting behavior in the afternoon (3 .30% with a cage temperature of 27,88 ^{o}C) and in the morning (0.00% with a cage temperature of 26,84 ^{o}C). Rokhman (2013), also reported that panting behavior in broiler chickens aged 15–33 days kept in cages with ambient temperature (temperature 29 ^{o}C) and in cages with heating (temperature 300 ^{o}C) also significantly increased compared to panting behavior in broiler chickens. which were kept in cages with air conditioning (temperature 23^{o}C).

Heart Rate Frequency in Broilers

Based on data in Table 1, it can be seen that the temperature of the cage at different times shows a very significant effect (P<0.01) on heart rate frequency in broiler chickens. The increase in heart rate during the day (temperature 30,15^{o}C) is the result of spasms in the coronary arteries so that the oxygen supply is reduced and the heart rate increases.

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Increasing the temperature in the cage causes stress in broiler chickens. Stress due to heat can result in speeding up the heart rate. Stress can result in accelerated spasms of the coronary arteries so that the blood supply to the heart muscle becomes disrupted. The future test by the Duncan Multiple Rate test showed that the cage temperature during the day (30,15^{o}C) significantly affected increased heart rate compared to the cage temperature in the afternoon (27,04^{o}C) and morning (26,01^{o}C). This is because the temperature of the cage during the day is a temperature that is above the comfort zone for broilers, so they begin to experience heat stress, while the temperature of the cage in the afternoon and morning is a temperature range that is still considered comfortable (tolerable).) by broilers and has not caused stress. By the opinion of Rosidi et al., (1999), the comfort zone for broiler chickens is 13–27^{o}C; 26–27^{o}C for adult chickens. Ridho (2013) added that at high environmental temperatures, there is an increase in heart rate. This increase is related to increased respiration which causes increased activity of the respiratory muscles, so that more blood is needed to supply oxygen and nutrients through the bloodstream by increasing the pulse rate, thereby speeding up the pumping of blood to the surface of the body and subsequently releasing body heat. On the other hand, at a comfortable temperature, there is no increase in respiratory muscle activity so the volume of blood pumped to supply oxygen to the heart remains normal and there is no increase in heart rate. Dewanti et al., (2014), reported that broiler chickens from the age of 15 days kept in cages with rice husk litter floors (temperature 30,71oC), wood shavings (temperature 30,55^{o}C), and rice straw (temperature 30,66^{o}C) produced heart rates which is not different, namely 330.33 times/minute (rice husk), 327.78 times/minute (wood shavings) and 328.00 times/minute (rice straw). This shows that the same cage temperature range also produces no different heart rate frequencies. However, the reported results have a higher average heart rate frequency than the results obtained from this study. By the opinion of Nesheim (1979), in general, the normal heart rate tends to be large in small animals and then becomes slower as the size of the animal increases.

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Rectal Temperature on Broiler

The research results in Table 1 show that cage temperature at different times showed a hight significant effect (P<0.01) on rectal temperature in broilers. The increase in rectal temperature in broiler chickens during the day (temperature 30,15oC) is an indication that the chicken is starting to suffer from heat stress. stated that high air temperatures can increase rectal temperature. The more stressed the chicken, the higher its rectal temperature (Qurniawan et al., 2016). The results of the Duncan Multiple Distance test showed that the cage temperature during the day (30,15^{o}C) significantly increased rectal temperature compared to the cage temperature in the afternoon (27,04^{o}C) and morning (26,01oC). This is because when the cage temperature is 30,15oC, The broilers begin to suffer from heat stress, which is indicated by an increase in rectal temperature, while at cage temperatures of 27,04^{o}C and 26,01^{o}C, this is a temperature range that can still be tolerated (comfort zone) so that broilers are not yet heat affected and this does not occur. increased rectal temperature. This condition causes poultry in high temperatures to have difficulty dissipating their body heat into the environment. The absence of sweat glands means limited methods of releasing excess heat in birds, unlike the evaporation of sweat from the skin. Broiler chickens are warm-blooded animals (homeothermic) that can regulate their body temperature because they have a thermoregulator system (body temperature control system) which consists of the hypothalamus, nervous system, and other components that are sensitive to temperature. Broilers tend to always maintain their body temperature (homeostasis) with a thermoregulation mechanism, namely regulating the balance of body heat between heat production and heat loss. Dewanti et al., (2014), reported broiler chickens starting at the age of 15 days reared in cages with litter floors of rice husks (temperature 30,71^{o}C), wood shavings (temperature 30,55^{o}C) and rice straw (temperature 30,66^{o}C) produced rectal temperatures that did not differ, namely 40,94^{o}C (rice husks), 40,94^{o}C (shavings wood) and 40.93^{o}C (rice straw). This shows that the same cage temperature range also produces no different rectal temperatures.

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However, the average rectal temperature reported from the research results of Dewanti et al., (2014) is lower than the results obtained from this study. Starting measurements on broilers with a smaller age and body weight than the age of the broilers in this study is the cause of the difference. By the opinion of Suprijatna et al., (2008), the chicken's body temperature also depends on the size of the chicken, the bigger the body, the more heat it will produce.

CONCLUSION

Based on the research results, it can be concluded that the temperature of the cage during the day produces respiratory frequency, heart rate frequency, and rectal temperature in broiler chickens which is very significantly higher than the temperature of the cage in the afternoon and morning, while the temperature of the cage in the afternoon produces a respiratory frequency. , the heart rate and rectal temperature were not significantly higher than the cage temperature in the morning

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