

Physiological Status of Indoor Sheep in the Tropical Rain Forest (HPGW) Environment

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Abstract

As an attempt to improve the animal health and production, agrosilvopastural (ASP) system has been introduced in the tropical countries. ASP system usually was established as a pasture of animals in the agriculture land or forestry environment, otherwise development ASP system with indoor animal in the tropical rain forest environment are still scare. Establishing of the animal production system in the tropical forest environment has a certain consequence related to the influence of physiological status and animal health. The objective of the study is to evaluate the physiological status of indoor sheep in the Gunung Walat Education Forest (HPGW)-IPB, Sukabumi-west Java-Indonesia which has tropical rain forest climatic type. Ten Javanese thin-tailed ewes, average body weight of 25 kg, in the indoor stable system were feed and water ad libitum under 24 hours continues monitoring of stable humidity and temperature. Measurement of hearth rate, respiration rate, and body temperature were carrying out to the each ewe in the morning and afternoon. This study reveals that the average humidity in the stable a day in the HPGW-IPB is (97.52 ± 4.87) % rel. and average temperature a day is (22.26 ± 1.62) °C. The consequence of bioclimatic condition is directly to the physiological status of the ewes, such as hearth rate by (71.00 ± 10.51) , respiration rate by (29.25 ± 5.39) and body temperature by (38.73 ± 0.56) °C. The average humidity a day in the stable shows uncomfortable for the animal health and production system, although the stable temperature is still comfortable enough. The condition is dominantly influenced by density and diversity of vegetation in the tropical rain forest. The high humidity in the stable affects enhancing of respiration rate of the ewes, although hearth rate and body temperature tend to the normal physiological value.

Keywords: *Animal physiology, bioclimatic, sheep, forest*

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Introduction

Utilization of natural resource and enhancing its added values denote as a new strategy to overcome the national crisis of food and industry material in Indonesia. Kinds of agribusiness formation have already executed to optimize the benefit of the natural resource in the forest land area. Therefore the forest land use management has to be encouraged to increase an added values and sustainability of forest natural resource. One of forest land use management is Agrosilvopastural (ASP) system. ASP system is the forest land use management which integrates between forest wood, crop and animal production. The integration has to be maintained as an attempt to gain the sustainable productivity and the most important it should be mutual and synergistic interaction to maintain the sustainable environment (Buck *et al.*, 1999).

The existence of the animal production activities in its ecosystem (forest environment) has been paid an attention in the veterinary and animal sciences fields. It due to the consequence of possible environment stress occurred, although the existence of animal could maintain the sustainability of agriculture and forest production through the utilization of animal excreta. A-biotic environment are the key factor for emerging physiological stress on the animal, especially temperature, humidity, rain fall (Yousef, 1984; Chantalakhana and Skunmun, 2002), wind, and sun radiation (Randall, 2002).

Animal production activities using the ASP system have to be directed on the maintaining of environment condition to be comfortable climate for animal (Singh, 2003). Optimum sheep productivity in the tropical region known that it could be reached on the temperature of 13⁰C – 18⁰C and humidity of 60 - 70% rel. (Dowell, 1972). The range of effective environment temperature which an animal can be reached optimum productivity without changing its basal metabolism to maintain constant body temperature (Thermoneutral Zone) is 10⁰C – 20⁰C (Collier, 1985) and critical temperature with decreasing feed intake and milk yield in cattle occurred above 30⁰C (McDowell, 1981). Williamson and Payne (1977) reported that the ideal microclimate for livestock in the tropic was temperature of 18⁰C – 21⁰C and humidity of 50% rel. – 60% rel.. Disturbance of health and production occasionally emerge on the suffering animal caused by heat and humidity stress (Singh, 2003). The microclimate in the region could influence the physiological condition of the animal. French (1970) reported that sheep and goat placed in the heat stress environment for long time could affect the thin performance, it caused by reduce body fat and fall of fur. Body temperature regulation on the mammalian and poultry are always controlled under constant level (homeothermis) for maintaining optimal physiological condition (Sturkie, 1981). The homeothermis could be maintained due to the balancing of metabolism heat production and heat loss to the environment (Cunningham, 2002). Air temperature and solar radiation affect the ability of animal to lose heat by convection, conduction, radiation; while relative humidity influences evaporative heat loss (Coiller, 1985).

The *Gunung Walat Education Forest* (HPGW)-IPB, located in Sukabumi-west Java-Indonesia on the 726 m above sea level altitude, with the kind of planted and wild canopy forest vegetation. *Agathis lorantifolia* (damar), *Pinus merkusii* (tusam), *Schima wallichii* (puspa), and *alpingia excelsa* (rasamala) are available dominant plantation in HPGW (Eli, 2002). The altitude and available vegetation condition in HPGW lead to influencing the microclimate in the region because of high level sun radiation absorption in the region (Yousef, 1984). Establishment of animal production system in the region (HPGW) pastures (outdoor) or caged (indoor) system has certain

consequence related to its influence of the physiological status and animal health. Up to now, still lack of information according to the physiological status of animal under influencing microclimate condition in tropical rain forest climatic type.

The objective of the study is to evaluate the physiological status of indoor sheep (heart rate, respiration rate, and body temperature) in the HPGW-IPB, which has tropical rain forest climatic type.

Materials and Methods

The measurement of parameters such as heart rate, respiration rate, and body temperature were conducted on the 10 Javanese thin-tailed ewes which average body weight of 25 kg. Simultaneously, the measurement of climatology data also was executed in HPGW region on day and date of 19.03.2005. All sheep were caged in the indoor system approximately 75 m² wide which canopy forest vegetation surrounding such as *Agathis lorantifolia* (damar). This stable is made by concrete wall and floor, corrugated asbestos roof, and approximately 3.25 m high from floor to the roof. Sheep were fed with 60% of mix grass and 40% of soy bean curd waste in different amount depend on body weight.

Measurement of physiological parameters

Some physiological parameters such as heart rate (beat/minute), respiration rate (inspiration/minute), and body temperature (°C) were measured using stethoscope, movement of thorax wall, and body thermometer respectively in this study. The measurement was carried out two times a day in the morning (08.00 – 09.00) and in the afternoon (17.00 – 18.00).

Measurement of climatology parameters

Two important parameters such as environment temperature (°C) and humidity (%rel.) in the indoor and outdoor were measured using automatic term-hygrograph for 24 hours. Recorded graphs obtained was analyzed and calculated to know the averages of temperature and humidity per day.

Results and Discussion

This study reveals that heart rate and body temperature on indoor sheep in HPGW region are still in the normal range of physiological status which respectively is (70.80 ± 10.65) beat/min and (38.73 ± 0.56) inspiration/min. Otherwise, abnormal respiration rate values of the sheep occurred (above level from normal values) in this study, (29.25 ± 5.39) inspiration/min. The physiological status of the indoor sheep in HPGW region can be seen on Table 1.

Table 1. The physiological status of the indoor sheep in HPGW region

Physiological Parameter	Values of Sheep in HPGW	Normal Values of Sheep*	Status
Heart Rate (beat/min)	70.80 ± 10.65	70 - 80	Normal
Respiration (inspiration/min)	29.25 ± 5.39	15 - 25	Abnormal
Body Temperature (°C)	38.73 ± 0.56	39,2 - 40	Normal

*: Smith and Mangkoewidjojo (1988)

The microclimate condition in HPGW region at the time are measured in the indoor system and outdoor system, which shows that humidity in both systems are extremely in above level from ideal humidity for animal in the tropic, respectively are $(96.40 \pm 6.95)\%$ rel. and $(94.92 \pm 8.07)\%$ rel.. Similar conditions with environmental temperature which indicate the slightly above level from thermoneutral zone, respectively are $(22.64 \pm 1.25)^\circ\text{C}$ and $(26.24 \pm 2.44)^\circ\text{C}$. The microclimate condition in HPGW at the time compared to the thermoneutral zone and ideal humidity for animal in the tropics showed in the Table 2.

Considering of the physiological and microclimate dates above, respiration rate abnormality occurring on the indoor sheep could be caused by high humidity level in the HPGW environment. Therefore the vapor pressure gradient are limited, consequently it influences evaporative heat lose. According to the homeiothermis for mintaining optimal physiological condition, the respiration rate have to be increased. Air temperature in the HPGW are still convenience for survival especially in the indoor system, although the dates show the slightly above level than thermoneutral zone. In the HPGW microclimate condition, the indoor sheep extremely suffering by humidity stress and its reveal the uncomfortable for enrichment productivty. The high humidity level in HPGW could be occurred might be as a concequency of density and diversity of vegetation in HPGW tropical rain forest.

Table 2. The microclimate condition in HPGW compared to the thermoneutral zone and ideal humidity in the tropic

Bioclimatology Parameter		Values in HPGW	Thermoneutral Zone ($^\circ\text{C}$)	Ideal Humidity in the Tropic (% rel.)
Indoor System	Temperature ($^\circ\text{C}$)	22.64 ± 1.25^a	$(10 - 20)^1$	$(60 - 70)^2$ $(50 - 60)^3$
	Humidity (% rel.)	96.40 ± 6.95^a		
Outdoor System	Temperature ($^\circ\text{C}$)	26.24 ± 2.44^b		
	Humidity (% rel.)	94.92 ± 8.07^a		

Means with different superscripts (a, b) in the same column are significantly different ($P < 0.05$)

¹: McDowell (1981)

²: Dowell (1972)

³: Williamson and Payne (1977)

Conclusion

Physiological status of indoor sheep in the tropical rain forest (HPGW) environment show the extremely suffering by humidity stress, therefore respiration rate abnormality could be occurred. This microclimate condition indicate the uncomfortable for enrichment productivity on the animal production system, but the average humidity and

temperature in the indoor sheep still convenience for survival. The condition is dominantly influenced by density and diversity of vegetation in the tropical rain forest.

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