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IMPACT OF TEMPERATURE AND HUMIDITY ON FEEDING REGIME OF WAD GOATS

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ABSTRACT

This study was carried out to determine the effects of microclimate in West African dwarf (WAD) goats pen. Trinal variation of ambient temperature (AT) and relative humidity (RH) were recorded at four hours intervals inside goat pen and temperature humidity index (THI) was calculated for the period of six(6) weeks. Twenty-eight WAD bucks aged 5 months with an average body weight of 7.00 ±0.2kg were fed cocoa pod, cassava pulp and Acacia leaf in a completely randomized experiment. The goats were randomly assigned to seven dietary treatments in different ratios of 0:60:40 (T1); 10:50:40 (T2); 20:40:40 (T3); 30:30:40 (T4); 40:20:40 (T5); 50:10:40 (T6) and 60:0:40 (T7) g/kg DM respectively. They were fed experimental diets once daily 8:00-9:00h, 1:00-2:00h and 6:00-7:00h in the morning, afternoon and evening, respectively. Data collected was subjected to analysis of variance using SPSS.The results obtained shown that the excursion ranges of temperature of morning, afternoon and evening-fed bucks was 29-31^{o}C, 31-34^{o}C,31-33^{o}C respectively. Relative humidity of 94-97%, 81-87.5%, 84-86% and Temperature Humidity Index (THI) was 85-87, 86-92 and 86-90 respectively for the week1. This study showed that period of time can entrain body temperature and physiological rhythm of an animal.In conclusion, feeding goats in the morning and evening may be an effective strategy to manage heat stress in the pen. Feeding in the afternoon should be avoided so as to avoid increased ambient temperature for the animals..

KEYWORDS: *Acacia Leaf, Cassava Pulp, Cocoa Pod, Goats, Microclimate*

INTRODUCTION

The microclimate which reflects the physical environment that is close to the animal can influence the performance and wellbeing of the animals (Thomas, 2012). Ruminants especially goats are homeotherms and can maintain their body temperature (Piccione, 2005). There are many factors that can influence the body temperature of the animals such as environmental conditions like temperature and humidity, feed availability and diseases (Stenvers, 2019). For example, time of feeding has been shown to influence the rhythmicity of expression in animals body temperature (Salfer and Harvatine, 2020).

The environmental conditions like climate are not stable and there is nothing farmers can do to stop it. As the climate changes, there can be increase or decrease in ambient temperature and humidity, which may result in unstable heat stress for the animals, especially in the tropics with an ambient temperature as high as (22-37^{o}C) (Shittu, 2016; BV, 2019). This increase in global temperature is unsuitable environmental conditions affecting livestock production(WMO, 2019). Feeding animals (goats) in the evening in hot weather minimized metabolic heat load during daytime when ambient temperature is high while more heat production will be shifted to night when the ambient temperature is low (Aharoni, 2005). Heat stress is unavoidable in the tropics and the effect can be nullified if the atmospheric temperature of microclimate falls below 21^{O}C for at least 3-6hours during the night time when the

animals dissipate their heat loads(Silanikove, 2000).

The temperature humidity index (THI) is a measure of both atmospheric temperature (AT) and relative humidity (RH) which is commonly used to determine the animal's discomfort. The THI value below 70 is considered comfortable, 72-78 is mild to moderate stress while 80 and above values is counted to be severe stress (Upadhyayand Singh2013).

As long as farmers cannot stop or influence climate change, it is advisable to determine the best time to feed animals in order to reduce the coincidence of high temperature and metabolic heat. This study aims to determine the effects of temperature and humidity in WAD goats pen

MATERIALS AND METHODS

Experimental Site

The study was carried out at the Teaching and Research farm of the Department of Animal Science, Landmark University, Omu Aran, Kwara State, Nigeria.

Experimental Animals and Design

Twenty-eight (28) West African dwarf goats (bucks), aged between 4 to 5 months with average body weight of 7.00±0.2kg was sourced from local livestock market in Ekiti. Previously, the nutritional properties of thirty (30) samples of silage prepared from combinations of cocoa pod, cassava pulp and Acacialeaf had been evaluated. From the results obtained, the best seven dietary combinations of cocoa pod, cassava pulp and Acacialeaf were chosen for the present experiment. They were designated as T1, T2, T3, T4, T5, T6 and T7 as presented in **Table 1**. Diet T1 was the positive control and contained no cocoa pod while T7 was a negative control with no cassava pod. Diet T2, T3, T4, T5 and T6 contained 10, 20, 30, 40, 50% of cocoa pod and 50, 40, 30, 20, 10% cassava pulp respectively. The animals were allotted to seven dietary treatments after 14 days of acclimatization in a completely randomized design with 4 animals per treatment under intensive system of management. One (1) goat was penned individually and replicated four (4) times.

EXPERIMENTAL PROCEDURE

Experimented Diets

Silage Preparation

Theobroma cacao(cocoa pods) was collected from a reputable cocoa farm and sundried to a moisture content of 37% and pounded (using mortar and pestle) to an average size of 0.6 cm^2. Cassava pulp was also gotten from a cassava processing farm and sundried to moisture content of 37% as described by Olawoye (2017).*Acacia leaves was also*harvested from pasture plant of Teaching and Research farm of the institution. The legume was allowed to wilt in open air for a day and thereafter chopped to 2-3cm size. The purpose of chopping and compacting the diets for silage was to ensure that all the air was pushed out of the plant material so that when the bag was sealed, the ensiled materials would be free of air.The wilted chopped *Acacia leaf, cocoa pod and cassava pulp*were mixed with over ripe banana (*Musa spp*.) slurry at rate of 5% of the weight of diets. Uniform compaction was ensured until the bags were filled and tightly tied packed in a polythene bag and put inside 20litres plastic and ensiled at 37^0C as described by Olawoye (2017). Each plastic was then compacted with a 20kg weight to remove air and create an anaerobic condition until expiration of fermentation (7weeks).

Table 1: Dietary Compositions of Combinations of Cocoa Pod, Cassava Pulp and Acacia Leaf Fed West African Dwarf Does (%)

Feed Ingredients Control					
	T_1	T_2	T_3	T_4	T_5
Cocoa pod	0.00	5.00	10.00	15.00	20.0
Cassava pulp	60.00	55.00	50.00	45.00	40.00
Acacia leaf	40.00	40.00	40.00	40.00	40.00
Total	100.00	100.00	100.00	100.00	100.00

Feeding Trials and Laboratory Analysis

The animals were housed in well-ventilated pens in an open sided housing system with corrugated aluminium roofing sheets and concreted slatted floor. The pen was fumigated with Izal solution two weeks prior to the commencement of the experiment. All the goats were weighed and randomly allotted to different dietary groups individually **(Table 1).** They were dewormed by using anthelmintic (Super Ivermectin), according to the body weight and sprayed with acaricide (Parannex) against external parasites. The goats were fed experimental diets once daily andfresh drinkable water were supplied (*ad libitum*) during the experimental period. The temperature and humidity of the pen were monitored at 8:00-9:00h, 1:00-2:00h and 6:00-7:00h in the morning, afternoon and evening, respectively usingAutomatic Temperature Humidity Measurement. The weight parameters were already published in one article under growth parameters.

DATA ANALYSIS

Data regarding meteorological variables suchas AT and RH was recordedcontinuously at four hours intervals using Easy-Log temperature and humiditydata logger (HTC Instruments, Mumbai, India). Thedata logger was fixed inside the experimental pensat about 1.5 meter above the floor**(Fig. 1).** Then consideringAT and RH together, the THI value was calculatedusing standard equation (Kendall, 2009).

- THI = [(0.8*AT+RT) * (AT-14.4) + 46.4];
- Where, AT = ambient temperature (ºC) and RH = relative humidity (%).
- THI= Temperature Humidity Index

Figure 1: Automatic Temperature Humidity Measurement.

RESULTS AND DISCUSSION

Microclimate of experimental pen

Trinal variation of AT, RH and THI inside thepen are presented in **Table. 2**. The mean AT inside thepen was 29.8±0.98^{o}C, 33.4±0.67^{o}C and 32±0.33^{o}Cin the morning, afternoon and evening respectively for week 1.The AT was at peak at 1:00-2:00pm (34^{O}C) The mean RH inside pens was 95.5±1.08%, 84.9±1.05% and 85.6±1.07% in the morning, afternoon and evening respectively and it was at peak in the morning (mean-95.5%) and at lowest level in the afternoon (mean-84.9%). The mean THI value inside the pen was observed to be 85.6±1.26, 90.1±1.56 and 87.8±1.23. The THI values fluctuated between 85-86 (8:00-9:00am), 91-92(1:00-2:00pm) and 86-87 (6:00-7:00pm).

Reduced Relative humidity (RH) inside the pens during the peak hours of AT might be attributed to higher evaporation rate of moisture in the air due to high Atmospheric temperature (AT). Likewise, reduced RH inside the pen during the peak hours of AT is better than higher humidity-higher temperature condition for the animals, as lower RH enhanced more evaporative heat loss from the body to the surrounding physical environment(Al-Dawood, 2017) (Al-Dawood, 2017). The THI values confirmed that the experimental pen provided comfortable microclimate to the goats during 6:00pm and 9:00am. Moreover, the rest part of the day shown that the microclimate was mild to moderate stressful to the goats (Upadhyayand Singh, 2013). Although, the microclimate around the experimental animals was stressful during the peak hours of AT, as a result of reduced RH, the impact has lesser negative effect on the goats. Upadhyay and Singh (2013) reported that the presence of thermal gradient between body and environmental temperature enhanced heat dissipation from the body, so the effect of thermal stress might be lesser during the peak hours of AT ((Al-Dawood, 2017).The atmospheric temperature in this study corroborates the study of Minka and Ayo (2016) and Aro*et al.* (2017) who reported 25.50-37.75^{o}C. The temperature humidity index (THI) revealed that bucks were heat stressed in the afternoon. Thus, feeding the goats (bucks) in the morning and evening can be a feeding strategy to manage heat stress in the tropics.

Table 2: Temperature and Humidity in WAD Goats Pen

TEMPERTURE HUMIDITY INDEX									
				WEEK ONE					
MORNING				AFTERNOON			EVENING		
DAYS	TEMP	HUMI	THI	TEMP	HUMI	THI	TEMP	HUMI	THI
1	31.05[a]	95.01[c]	87.00[a]	34.36[b]	85.48[c]	91.37[b]	33.00[a]	86.04[b]	90.46[a]
2	29.90[c]	96.04[b]	86.03[b]	31.05[d]	86.00[b]	86.40[c]	32.70[a]	85.43[c]	89.21[b]
3	29.00[c]	97.03[a]	85.01[c]	32.50[c]	84.02[d]	89.46[c]	32.47[b]	86.20[b]	88.34[b]
4	30.03[b]	96.00[b]	86.12[b]	35.45[a]	81.35[d]	91.00[b]	31.00[c]	88.00[a]	86.41[d]
5	29.50[c]	94.45[d]	85.26[c]	33.90[b]	87.50[a]	92.30[a]	31.50[c]	84.32[d]	87.00[c]
6	29.50[c]	95.24[c]	85.46[c]	34.00[b]	86.11[b]	92.00[a]	32.36[b]	85.20[c]	87.40[c]

Table 3: Temperature and Humidity in WAD Goats Pen

				WEEK TWO					
MORNING				AFTERNOON			EVENING		
DAYS	TEMP	HUMI	THI	TEMP	HUMI	THI	TEMP	HUMI	THI
1	29.02b	99.00a	85.00b	32.50c	96.58a	92.40b	28.50c	99.00a	84.02d
2	28.50[c]	99.23[a]	94.00[a]	34.04[b]	96.55[a]	94.00[a]	32.04[b]	96.03[b]	90.00[a]
3	29.32[b]	94.28[d]	84.18[c]	35.00[a]	79.50[d]	91.34[c]	32.00[b]	81.05[d]	87.04[b]
4	30.00[a]	94.30[d]	84.00[c]	35.20[a]	80.01[d]	91.04[c]	33.39[a]	82.00[c]	89.57[a]
5	29.43[b]	96.42[c]	85.06[b]	30.20[d]	95.00[b]	85.33[d]	29.50[c]	96.45[b]	86.05[c]
6	29.34[b]	98.00[b]	85.32[b]	34.00[b]	88.00[c]	92.00[b]	33.00[a]	75.00[e]	87.00[b]

Table 4: Temperature and Humidity in WAD Goats Pen

				WEEK THREE					
MORNING				AFTERNOON			EVENING		
DAYS	TEMP	HUMI	THI	TEMP	HUMI	THI	TEMP	HUMI	THI
1	29.06[b]	99.05[a]	85.03[b]	31.50[b]	97.03[b]	88.34[b]	30.22[b]	97.03[a]	85.00[b]
2	29.00[b]	99.03[a]	85.04[b]	33.06[a]	97.45[b]	92.00[a]	31.05[a]	97.34[a]	88.00[a]
3	27.53[d]	99.43[a]	81.33[d]	31.46[b]	98.04[a]	88.05[b]	29.00[c]	96.22[b]	85.30[b]
4	27.50[d]	99.26[a]	81.24[d]	30.50[c]	96.00[c]	87.44[c]	28.75[d]	96.45[b]	83.20[c]
5	28.80[c]	98.00[b]	83.35[c]	29.53[c]	98.00[a]	86.23[d]	29.04[c]	97.25[a]	85.24[b]
6	30.05[a]	96.04[c]	86.00[a]	29.15[d]	96.34[c]	85.14[e]	29.26[c]	96.26[b]	85.35[b]

Table 5: Temperature and Humidity in WAD Goats Pen

				WEEK FOUR					
MORNING				AFTERNOON			EVENING		
DAYS	TEMP	HUMI	THI	TEMP	HUMI	THI	TEMP	HUMI	THI
1	30.00[a]	99.00[a]	86.07[b]	35.33[a]	96.33[b]	95.07[a]	31.50[b]	97.00[a]	88.00[b]
2	29.05[b]	98.00[b]	85.37[c]	32.84[b]	97.00[a]	90.76[c]	31.85[b]	96.05[b]	88.03[b]
3	29.34[b]	99.35[a]	85.45[c]	35.45[a]	94.50[c]	94.4[b]	32.00[a]	94.53[c]	89.06[a]
4	29.44[b]	97.53[c]	85.37[c]	33.00[a]	95.43[c]	91.34[c]	32.07[a]	95.00[c]	89.34[a]
5	29.28[b]	98.53[b]	85.00[c]	32.06[b]	95.25[c]	89.0[d]	31.53[b]	95.46[c]	89.44[a]
6	29.04[b]	95.00[d]	89.05[a]	31.38[c]	86.50[d]	86.53[e]	32.34[a]	85.07[d]	87.34[c]

Table 6: Temperature and Humidity in WAD Goats Pen

				WEEK FIVE					
MORNING				AFTERNOON			EVENING		
DAYS	TEMP	HUMI	THI	TEMP	HUMI	THI	TEMP	HUMI	THI
1	29.44^{d}	95.00^{c}	84.00^{e}	32.80^{c}	94.04^{c}	90.00^{d}	30.00^{d}	95.30^{b}	85.00^{e}
2	32.30^{b}	95.30^{c}	89.48^{c}	34.50^{b}	94.00^{c}	94.44^{c}	31.00^{d}	95.50^{b}	87.00^{d}
3	32.45^{b}	95.40^{c}	89.45^{c}	33.50^{c}	95.06^{b}	92.40^{b}	34.50^{a}	95.06^{b}	94.00^{a}
4	33.00^{a}	96.00^{b}	92.00^{a}	36.50^{a}	95.00^{b}	97.00^{a}	33.00^{b}	95.00^{b}	91.34^{b}
5	31.45^{c}	98.50^{a}	88.33^{d}	30.80^{d}	96.00^{a}	86.00^{e}	29.20^{e}	96.50^{a}	85.03^{e}
6	32.35^{b}	96.34^{b}	90.34^{b}	35.00^{b}	95.03^{b}	94.44^{c}	32.00^{c}	95.03^{b}	89.00^{c}

Table 7: Temperature and Humidity in WAD Goats Pen

				WEEK SIX					
MORNING				AFTERNOON			EVENING		
DAYS	TEMP	HUMI	THI	TEMP	HUMI	THI	TEMP	HUMI	THI
1	30.70^{b}	96.00^{b}	88.00^{a}	36.00^{a}	89.58^{d}	95.78^{b}	32.70^{a}	90.00^{c}	88.05^{b}
2	31.00^{a}	96.00^{b}	88.00^{a}	31.00^{e}	96.00^{b}	88.00^{e}	30.50^{c}	96.56^{a}	88.00^{b}
3	31.00^{a}	97.00^{a}	88.00^{a}	35.50^{b}	94.00^{c}	96.00^{b}	33.00^{a}	96.50^{a}	91.00^{a}
4	30.50^{b}	97.50^{a}	88.04^{a}	34.20^{c}	97.00^{a}	94.00^{c}	30.50^{c}	82.50^{d}	85.56^{c}
5	30.20^{b}	97.00^{a}	86.00^{b}	36.50^{a}	90.00^{d}	97.00^{a}	30.57^{c}	94.70^{b}	84.00^{d}
6	31.05^{a}	97.06^{a}	88.05^{a}	33.00^{d}	89.67^{d}	90.00^{d}	29.80^{d}	95.00^{b}	85.00^{c}

CONCLUSIONS

The results of this study revealed that microclimate close to the animals showed marked trinal fluctuation and during afternoon was mild to moderate stressful to the animals inside the pen. Reduction in the ambient temperature in the evening provides sufficient duration to the animals for heat dissipation.

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Conflict of Interest

Authors declared that there was no conflict of interes

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