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BREED, SEX AND AMBIENT TEMPERATURE EFFECTS ON DURATION OF BEHAVIOURAL TRAITS OF RABBITS (*Oryctolagus Cunniculus*) REARED IN THE HUMID TROPICS

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ABSTRACT: *Breed, sex and ambient temperature effects on the nocturnal and diurnal duration of feed and water intakes, standing and lying down behaviour of rabbits were investigated. Twelve male and female weaner rabbits (New Zealand White, Dutch Black and American Chinchilla, 8 weeks old) were housed individually in cells measuring 51 cm x 51 cm each. They were fed an 18% Crude Protein pelleted diet, forages (Centrosema pubescens, Ipomea batatas and Tridax procumbens) and water ad libitum for 8 weeks. Data were collected at three hourly intervals from 18:00 hrs to 06:00 hrs (nocturnal) and from 06:00 hrs to 18:00 hrs (diurnal). Durations of feed intake, water intake, lying down and standing were measured. Ambient temperature differed significantly ($P \leq 0.05$) between test periods. Breed and sex did not influence the parameters studied. While ambient temperature significantly ($P \leq 0.05$) influenced all traits, test period significantly ($P \leq 0.05$) influenced duration of water intake, duration of standing and duration of lying down but not duration of feed intake. Interaction effects of test period x ambient temperature affected ($P \leq 0.05$) duration of water intake and duration of lying down within the nocturnal period and duration of feed intake, duration of water intake and duration of lying down within the diurnal period. Highly significant ($P < 0.01$) phenotypic correlation was observed between duration of feed intake and duration of standing ($r_p = 0.10$), duration of feed intake and duration of lying down ($r_p = -0.46$), duration of water intake and duration of standing ($r_p = 0.09$), duration of water intake and duration of lying down ($r_p = -0.29$), ambient temperature and duration of water intake ($r_p = 0.64$), duration of standing and duration of lying down ($r_p = -0.51$) and between ambient temperature and duration of lying down ($r_p = -0.42$).*

Key words: *Ambient Temperature, Behavioural Trait, Diurnal, Ethology, Nocturnal, Rabbit, Stress, Test Period, Thermoneutrality*

ORIGINAL ARTICLE

INTRODUCTION

Ethology is the science of animal behaviour (Mathur, 2005). Animal behaviour is the totality of the observable behavioural repertoire of an animal in a given environment. Behaviour is also described as any observable action and interaction between the organism's motivational state and the perceived attributes (stimuli) of its environment (Marai and Rashwan, 2004; Dosenbery 2009). Behaviour is therefore one of the most important functions of animal life and animal behaviour is a vital link between the organism and the environment and between the body control systems (nervous, muscular, endocrine) and the ecosystem. Behaviour plays a critical role in animal adaptation and evolution. Through behaviour an animal interacts with its environment and such interactions provide clues of the state of the environment and its probable impacts on life forms. Welfare is a condition of the animal itself. Animal behaviour provides the barometer for assessing animal welfare and there can be no animal welfare without an understanding of the normal behaviour of the animal. Animal behaviour therefore constitutes an extremely important aspect of a species survival strategy (Mathur, 2005). Animals differ in their response to changes in external and internal environments and may be innate or acquired and depend on both genetic disposition and ontogenic experience. Even within the same species, genetic differences exist among individuals of a population in their response to the same environmental stimuli (Batchelor, 1991; Manteuffel, 2002; Anna and Lance, 2005; Ogunjimi et al., 2008). All animals possess a range of behavioural expectations regarding their environment, in order to maintain their physical and psychological health. Different behavioural attributes have a specific function to the animal which can be associated to relaxation, ingestion, excretion, reproduction, exploratory, freight, attack, adaptive and care soliciting. Thus an animal's behaviour at each point in time reflects

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its perception of the environment as favourable or stressful. Understanding the impact of the production environment is critical to animal welfare and performance and a clear perception of the proximate and ultimate causations of an animal's behaviour is important for its survival, well being and for maximum benefits from the animal (Mathur, 2005).

Among the many aspects of ethology, animal scientists are interested in the feeding and adaptive behaviours of animals under varied environmental conditions: ambient temperature (AT), relative humidity, air movement, solar radiation and photoperiod (Marai et al., 1991; Marai and Rashwan, 2004). Ambient temperature is perhaps the most important environmental factor affecting nutrient intake and therefore the well being of animals in the humid tropics (Marai et al., 1991; Marai and Rashwan, 2004; Svotwa et al., 2007). Animals in their thermoneutral zone (TNZ) use the standing posture for exercise, exploration, nutrient ingestion and mating while the lying down posture is used mainly for relaxation. Both postures are however vital for thermoregulation during thermal stress. Animals alter posture to dissipate, or conserve heat depending on the AT.

In the wild, the rabbit is a nocturnal animal nesting in the warrens throughout the day and emerging at dusk to forage for food until early morning. This nocturnal behaviour may have evolved to escape predators (survival) and/or take advantage of the more benign environmental AT during this period especially in the tropics. However, domestication and intensive husbandry may have altered this behaviour. Krohn et al. (2000) reported that the welfare of rabbits reared intensively can be improved by feeding the animals in the afternoon rather than in the early morning while James and Kim (2010) reported that rabbits eat at all times of the day. The eating frequency and duration of animals including rabbits varies with AT (Armstrong, 1994). Fayez and Alnaimy (2000) reported that as AT fell from 21 °C to 10 °C, feed intake and feeding frequency in rabbits increased while feeding stopped as the AT fell below 10 °C. The same authors noted that as the AT increased from 21 to 30 °C feeding frequency; feed intake and duration reduced while feeding stopped entirely following rise in ambient temperature above 34 °C. In addition, Marai et al. (1991) reported that above 35 °C rabbit can no longer regulate their internal temperature while Marai and Rashwan (2004) stated that at 25 – 30 °C, rabbits stretch out to loose as much heat as possible by radiation and convection. Thus rabbits like other mammals tolerate lower ATs better than higher AT (Nedergard et al., 1990; Carey et al., 2003). AT range of 21 °C - 25 °C is known as the "comfort zone" or zone of thermo neutrality for rabbits (Marai et al., 1991) and at this temperature range (21-25°C) feed consumption is optimum. In the present study the effects of breed, sex, and ambient temperature (AT) on the diurnal and nocturnal feed and water intake durations and durations of standing (DS) and lying down (DLD) of rabbits reared in the humid tropics were determined.

MATERIALS AND METHODS

A total of twenty-four weaner rabbits about 8 weeks old belonging to three breeds namely: Newzeland White, Dutch Black and American Chinchilla were used for the study. The rabbits were housed initially in four hutches (114 cm x 102 cm x 51 cm) for two weeks to adapt to the environmental conditions of the rabbitry. The floor of the hutch was bedded with wood shavings to 2cm thick. During this period feed, water, vitamin and mineral supplements as well as prophylactic antibiotic medications were provided to the animals to ensure good health and vitality. After the two weeks pre-experimental period, 12 apparently healthy rabbits (4 per breed and 2 per sex) were selected, weighed and housed individually in cells measuring 51 cm x 51 cm each. The rabbits were fed with an 18% CP diet, a combination of forages-*Centrosema pubescens*, *Ipomea batatas* and *Tridax procumbens* - and water *ad libitum* during the 8 weeks experimental period. Data for the nocturnal activities were collected three days per week between time periods 18:00 hrs to 06:00 hrs while data for the diurnal activities were collected one day per week between time periods 06:00 hrs to 18:00 hrs. The parameters measured included the durations of feed and water intakes, lying down and standing to rest/explore the environment. The nocturnal and diurnal recordings were taken three hourly for four time intervals namely: 1800 hrs – 21:00 hrs, 21:00 hrs – 00:00 hrs, 00:00 – 03:00 hrs and 03:00 hrs – 06:00 hrs (nocturnal) and 06:00 hrs – 09:00 hrs, 09:00 hrs – 12:00 hrs, 12:00 hrs – 15:00 hrs and 15:00 hrs – 18:00 hrs (diurnal). The temperature (°C) inside the rabbit hutches were measured within the same three hourly intervals. Observation of the animals took place from a building directly opposite the rabbitry. The dorsal pinnae of each rabbit was marked with a colour marker to enhance observation from a distance. Behavioural activities of the rabbits were recorded in minutes using stop watches. Data collected were subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) using the ANOVA option of SPSS computer package version 17.0 (SPSS Incorporate, 2001). Significantly different means were separated using Duncan's New Multiple Range Test option of SPSS.

RESULTS

The ranges of ambient temperatures in the rabbitry during the test periods (nocturnal and diurnal test periods) are presented in Table 1 while the effects of the factors (breed, sex and ambient temperature) on the traits studied are presented in Table 2. Table 1 shows that within the nocturnal test period, ambient temperature range (AT range) was significantly ($P \le 0.01$) highest within 18:00 – 21:00 hrs (mean, 25.89 ± 0.19 °C) and significantly ($P \le 0.01$) lowest during 03:00 – 06:00 hrs (mean, 23.80 ± 0.19 °C). For the diurnal period, AT range was highest within 12:00 – 15:00 hrs (mean, 30.52 ± 0.27 °C) and least during 06:00 – 09:00 hrs (mean, 25.46 ± 0.27 °C).

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Table 1 - Range of ambient temperature in the rabbitry during the experiment

Test period					
Nocturnal			Diurnal		
Time period (hr)	ATR (oC)	Mean	Time period (hr)	ATR (oC)	Mean
18:00-21:00	24.8-28.3	25.89 ± 0.19^{a}	06:00-09:00	24.0-27.8	25.46 ± 0.27^{d}
21:00-00:00	22.5-26.5	24.49 ± 0.19^{b}	09:00-12:00	26.8-30.5	28.16 ± 0.27^{c}
00:00-03:00	22.0-25.8	23.88 ± 0.19^{c}	12:00-15:00	29.5-32.0	30.52 ± 0.27^{a}
03:00-06:00	22.5-25.5	23.80 ± 0.19^{c}	15:00-18:00	28.5-31.0	29.21 ± 0.27^{b}

$^{a,b,c,d:}$ means on the same column with different superscripts are significantly different ($P \leq 0.05$), ATR: range of ambient temperature.

Thus, both the minimum and maximum mean ATs were higher for the diurnal period compared to the nocturnal period (25.46 ± 0.27 vs 23.80 ± 0.19 and 30.52 ± 0.27 vs 25.89 ± 0.19, respectively). Mean AT ranged from 22.0 – 28.3 °C during the nocturnal period and 24.0 – 32.0 °C during the diurnal period.

Table 2 shows that breed and sex of rabbits did not significantly influence any of the parameters studied. Duration of water intake (DWI), duration of standing (DS) and duration of lying down (DLD) were however, significantly ($P \leq 0.05$) affected by test period (that is, nocturnal or diurnal periods).

Table 2 - Effects of breed, sex and test period on duration of behavioural traits of rabbits

Trait	Breed			Sex		Test period	
	NZW	DB	AC	M	F	Nocturnal	Diurnal
DFI	31.86 ± 1.0	33.95 ± 1.3	32.30 ± 0.9	31.86 ± 0.9	33.05 ± 0.8	32.10 ± 0.7	33.28 ± 1.1
DWI	1.98 ± 0.2	1.97 ± 0.2	1.98 ± 0.1	2.00 ± 0.1	1.95 ± 0.1	0.80 ± 0.1^{b}	5.51 ± 0.2^{a}
DS	34.45 ± 0.8	33.96 ± 1.6	33.94 ± 0.7	33.56 ± 0.7	34.57 ± 0.6	34.82 ± 0.5^{a}	31.94 ± 1.1^{b}
DLD	104.49 ± 1.6	102.78 ± 1.8	101.58 ± 1.3	102.97 ± 1.3	102.57 ± 1.2	110.44 ± 0.9^{a}	79.68 ± 1.9^{b}

$^{a,b:}$ means on the same row with different superscripts are significantly different ($P \leq 0.05$), NZW: Newzeland White, DB: Dutch Black, AC: American Chinchilla, M: male, F: female, DFI: duration of feed intake, DWI: duration of water intake, DS: duration of standing, DLD: duration of lying down.

Duration of water intake was longer during the diurnal than nocturnal test period while durations of standing and lying down were respectively, longer during the nocturnal test period compared to the diurnal test period. Duration of feed intake did not differ according to test period.

Figures 1 and 2 present the effects of ambient temperature (AT) on the parameters studied. From Figure 1a, duration of feed intake (DFI) was longest at AT range of 24 – 28 °C followed by 28 – 30 °C and least at AT range of 30 – 32 °C. From AT range of 26 – 28 °C, duration of feed intake decreased progressively to its least value of 25.3 min. at AT range of 30 – 32 °C. For duration of water intake (DWI), rabbits drank for longest period at AT range of 30 – 32 °C (9.0 min.) followed by 26 – 28 °C (6.4 min) and for shortest duration of 0.5 min. at AT range of 22 – 24 °C. Contrary to the observed trend for feed intake, duration of water intake (Fig. 1b) significantly ($P \leq 0.05$) increased from AT range of 22 – 24 °C (0.5 min.) to 26 – 28 °C (6.4 min.), decreased within AT range of 28 – 30 °C (5.0 min) and then significantly ($P \leq 0.05$) rose to its highest value of 9.0 min at AT range of 30 – 32 °C. A milder response to the effect of AT was observed for duration of standing (DS) (Fig. 2a).

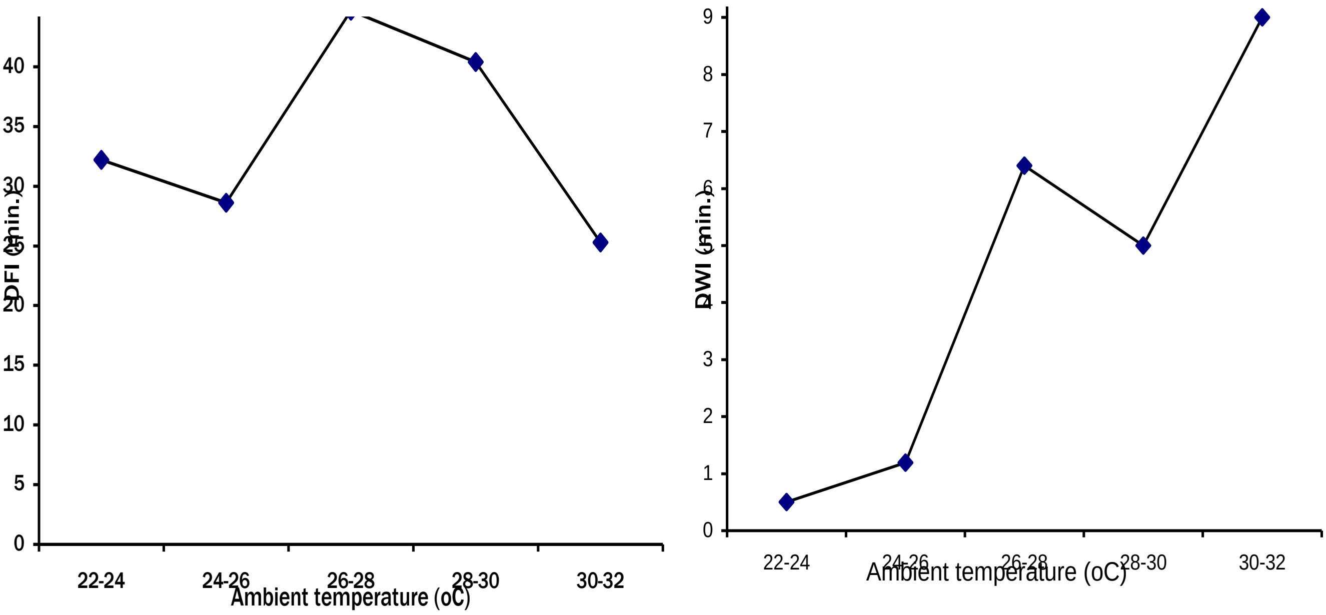

Figure 1 - Effect of ambient temperature on duration of feed and water intake: (A) feed intake, (B) water intake, DFI: duration of feed intake, DWI: duration of water intake, min.: time in minutes.

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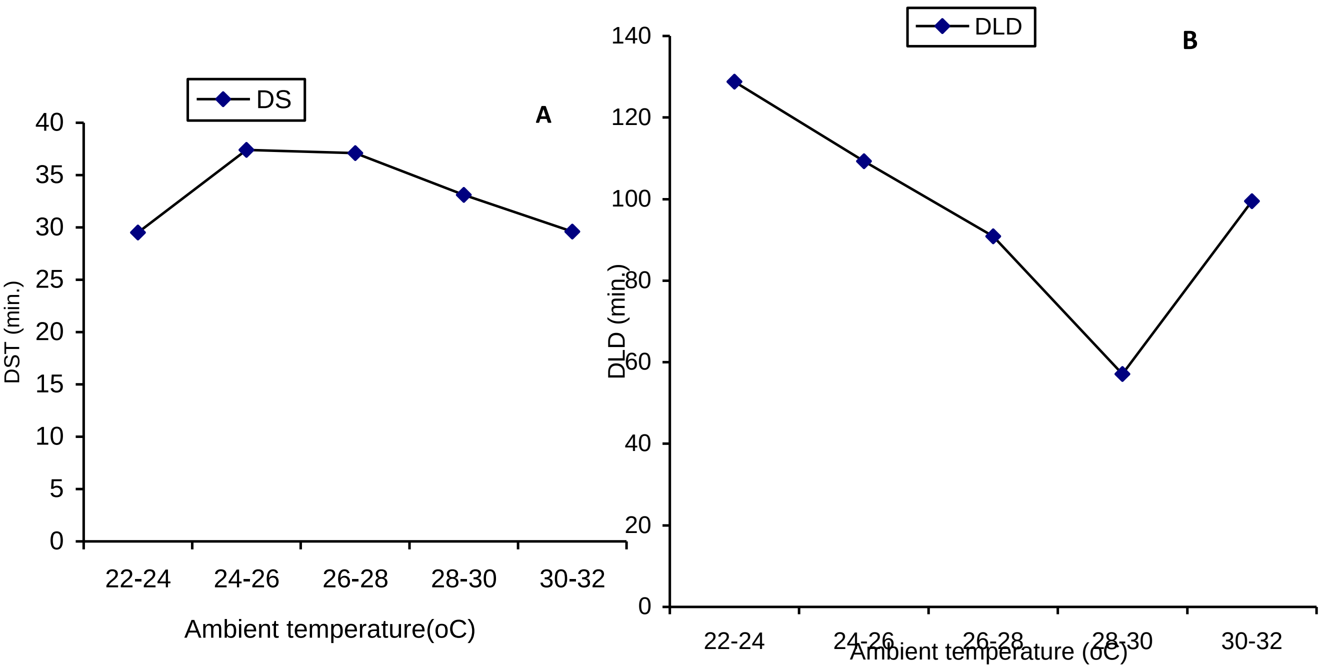

Figure 2 - Effect of ambient temperature on duration of standing and lying down in rabbits. (A) standing, (B) lying down, DS: duration of standing, DLD: duration of lying down, min.: time in minutes.

DS was longest within AT range of 24 – 26 °C and 26 – 28 °C (37.4 min. and 37.1 min., respectively) but shortest for 22 – 24 °C and 30 – 32 °C (29.5 min. and 29.6 min., respectively). For duration of lying down (DLD), rabbits laid down for longest duration within AT range of 22 – 24 °C (128.8 min) and least within AT range of 28 – 30 °C (57.1 min.). Duration of lying down decreased progressively from the highest value of 128.8 min. within AT range of 22 – 24 °C to its least value of 57.1 min. within AT range of 28 – 30 °C before it shot up again to 99.5 min within AT range of 30 – 32 °C which was similar to the value obtained for AT range of 24 – 26 °C and 26 – 28 °C (109.3 min. and 90.9 min, respectively).

The effects of interaction of test period (nocturnal or diurnal) x ambient temperature on duration of the parameters studied are presented in Table 3.

Table 3 - Effect of test period x ambient temperature interaction on duration of behavioural traits of rabbits

Test period									
Nocturnal					Diurnal				
ATR (oC)	DFI (min.)	DWI (min.)	DS (min.)	DLD (min.)	ATR (oC)	DFI (min.)	DWI (min.)	DS (min.)	DLD (min.)
21-23	22.7 ± 11.5	Nil	28.5 ± 10.7	131.9 ± 18.8^{a}	23-25	19.0 ± 15.6^{b}	1.8 ± 1.8^{c}	35.2 ± 14.0	120.3 ± 26.1^{a}
23-25	27.6 ± 6.9	0.6 ± 0.7^{b}	34.1 ± 5.4	117.9 ± 9.5^{a}	25-27	42.2 ± 13.5^{a}	4.1 ± 1.8^{bc}	39.6 ± 12.8	90.2 ± 16.4^{ab}
25-27	34.8 ± 9.3	1.8 ± 0.9^{ab}	37.3 ± 6.5	102.8 ± 11.4^{ab}	27-29	38.1 ± 12.0^{ab}	6.2 ± 1.6^{b}	36.6 ± 11.4	54.9 ± 20.0^{b}
27-29	26.0 ± 18.3	3.5 ± 1.8^{a}	39.5 ± 13.5	82.8 ± 23.8^{b}	29-31	31.5 ± 9.2^{ab}	7.3 ± 1.72^{ab}	35.5 ± 12.0	72.9 ± 21.1^{ab}
					31-32	11.4 ± 12.3^{b}	10.4 ± 1.7^{a}	19.4 ± 11.7	112.0 ± 20.6^{a}

^{a,b}: means on the same column with different superscripts are significantly different ($P \le 0.05$), ATR: range of ambient temperature, DFI: duration of feed intake, DWI: duration of water intake, DS: duration of standing, DLD: duration of lying down, min.: time in minutes.

The table shows that DFI and DS did not differ significantly within the range of ATs observed during the nocturnal test period. DWI differed significantly ($P \le 0.05$) with rabbits spending significantly ($P \le 0.05$) longer time of 3.5 ± 1.8 min. drinking within AT range of 27 – 29 °C compared to the value of 0.6 ± 0.7 min obtained within AT range of 23 – 25 °C. Duration of feed and water intakes as well as lying down varied significantly ($P \le 0.05$) among AT range values within the diurnal test period. For DFI, rabbits spent significantly ($P \le 0.05$) longer time feeding within AT ranges of 25 – 27 °C (42.2 ± 13.5 min.), 27 – 29 °C (38.1 ± 12.0 min.) and 29 – 31 °C (31.5 ± 9.2 min.) compared to the time duration of 19.0 ± 15.6 min and 11.4 ± 12.3 min. obtained within AT ranges of 23 – 25 °C and 31 – 32 °C, respectively. For water intake, rabbits spent significantly ($P \le 0.05$) longer time drinking when AT was between 31 – 32 °C (10.4 ± 1.7 min.) and 29 – 31 °C (7.3 ± 1.7 min.) compared to the values for AT ranges of 27 – 29 °C (6.2 ± 1.6 min.), 25 – 27 °C (4.1 ± 1.8 min.) and 23 – 25 °C (1.8 ± 1.8 min.). Duration of lying down was significantly ($P \le 0.05$) shortest within AT range of 27 - 29 °C at 54.9 ± 20.0 min. compared to other AT range values.

The correlation matrix for ambient temperature and duration of behavioural traits studied is presented in Table 4. Significant ($P \le 0.01$) positive correlation (r_g) was obtained between DFI and DS; DWI and DS and DWI and AT. Duration of feed intake and DLD; DWI and DLD as well as DS and DLD were significantly ($P \le 0.01$) negatively correlated. Similarly, DLD was significantly ($P \le 0.01$) negatively correlated with AT (r_g, -0.42).

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Table 4 - Correlation matrix for ambient temperature and duration of behavioural traits of rabbits					
Trait	DFI	DWI	DS	DLD	AT
DFI		0.03	0.10**	-0.46**	0.31
DWI			0.09**	-0.29**	0.64**
DS				-0.51**	-0.02
DLD					-0.42**

**: significant at P ≤ 0.01 (2 tailed), DFI: duration of feed intake, DWI: duration of water intake, DS: duration of standing, DLD: duration of lying down.

DISCUSSION

The significantly higher AT range during the diurnal period compared to the nocturnal period was expected. Whereas direct solar radiation heats up the earth's atmosphere during the day (diurnal period), large amount of heat energy escapes from the earth into space during the night (nocturnal period) such that the earth's atmosphere is cooled during this period. Diurnal AT range and mean AT were lowest (24.0 – 27.8 °C and 25.46 ± 0.27 °C, respectively) during the time period following the nocturnal period (06:00 – 09:00 hrs) reflecting the effects of heat loss during the nocturnal period while nocturnal AT range and mean AT were highest (24.8 – 28.3 °C and 25.89 ± 0.19 °C, respectively) during the time period following the diurnal period (18:00 – 21:00 hrs) reflecting the effects of heat gain from solar radiation during the diurnal period. Thus mean minimum and maximum ATs were expectedly higher for the diurnal period compared to the nocturnal period (25.46 ± 0.27 °C vs 23.80 ± 0.19 and 30.52 ± 0.27 vs 25.89 ± 0.19, respectively). These higher diurnal ATs mean that rabbits reared intensively in the tropics are exposed to ATs above their thermoneutral zone (TNZ) (Marai and Rashwan, 2004) especially during the diurnal period and are therefore thermally stressed. The lower ATs of the nocturnal period offer opportunity to loose substantial body heat and to cope with the high tropical ATs.

The insignificant (P > 0.05) breed and sex effects (Table 2) and breed x sex interaction effects (not shown) on the parameters studied was not surprising. The three breeds of rabbits used in the present study are the commonest exotic breeds reared in Nigeria and these breeds may have adapted substantially to the tropical environment. Marai et al. (1991) reported that animals routinely kept under high ATs develop metabolic mechanisms to adapt to heat stress and that in the tropics; New Zealand White rabbits are successfully raised under conditions in which the AT is consistently in the range 32.2 – 35.0 °C. The highly significant (P < 0.01) differences between nocturnal and diurnal durations of water intake, standing and lying down postures are consequences of the AT differences between these test periods as well as the natural (nocturnal) behavioural inclination of rabbits. Expectedly, DWI was shorter during the nocturnal period as the rabbits needed less water during the low temperature regimens characteristic of this period. Again, domesticated and intensively reared nocturnal animals become less nocturnal overtime and hence sleep/rest for most of the night periods. Duration of standing was significantly (P ≤ 0.05) higher during the nocturnal period probably in response to the more benign AT regimen of this period and/or due to the natural inclination for nocturnal exploration. The shorter time spent standing during the diurnal period was hence in response to the generally higher diurnal ATs as well as the need for some other more important activities like feed and water intakes and lying down to rest and/or loose heat in order to regulate body temperature. Marai and Rashwan (2004) reported that in warm environment (37.2 – 42. 2 °C), bunnies 5 – 10 weeks lie spread on their sides on the floor to loose body heat. Older rabbits exhibit similar behaviour at a lower AT range of 25 – 30 °C. Daily feed intake did not differ significantly between test periods probably because rabbits equally utilize the nocturnal and diurnal time periods for feeding. Ruminant livestock exhibit increased grazing activities towards dusk and just before dawn in response to more benign ATs.

The significantly (P ≤ 0.05) higher duration of feed intake (Fig. 1a) and by extension the quantity of feed consumed at AT range of 26 – 28 °C which was recorded between 18:00 and 21:00 hrs (nocturnal period) and 06:00 – 12:00 hrs (diurnal period) (Table 1) indicates that this temperature range probably corresponds to or is close to the thermoneutral zone (TNZ) of the rabbits used in the present study or that the above time periods were the peak periods for feed intake in rabbits reared in our environment or that a positive interaction effect exists between ambient temperature and time period in this instance. Thermal comfort zone for any animal is a function of the climatic and weather variables of its environment (Marai et al., 1991). Thus animals reared in the hot humid tropical environment acquire overtime the capacity to tolerate higher heat threshold than their counterparts reared in the temperate environments (Finzi, et al., 1988; Marai et al., 1991; Mayer and Bucklin, 2009). Consequently, tropically adapted breeds have higher TNZ than their temperate counterparts (Hansen, 2004; Mayer and Bucklin, 2009). The shorter duration of feed intake at AT range of 22 – 24 °C (nocturnal period: 00:00 – 03:00 hrs) indicate low feeding activity in the rabbits within this time period in spite of the lower and probably more comfortable thermal environment. The steep decline in time spent feeding as AT rose to 30 °C and above (diurnal period: 12:00 – 18:00 hrs) indicate the adverse effect of high AT on nutrient ingestion. Animals eat to generate energy for body functions and other activities. The excess is lost to the environment through sensible and insensible heat loss mechanisms (Gates et al., 2001; Marai et al., 2002; Hansen, 2004; Marai et al., 2008; Hansen, 2009). Inability to dissipate excess body heat due to high ATs triggers a series of coping or homeostatic strategies (Horowitz, 2002; Bernabucci et al., 2010) involving hormonally mediated feed-back mechanisms which depress feed intake, increase water intake, reduce the rate of body metabolic activities and hence internal heat production (Marai and Rashwan, 2004; Svotwa et al., 2007; Villalobos et al., 2008; Bernabucci *et al.*, 2010; Marai and Nardone, 2010).

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The adverse effects of high environmental temperatures on duration of grazing in ruminants and feed intake in other livestock species have been extensively studied (Silanikove, 2000; Marai et al*.,* 2008; Bernabucci et al*.,* 2010). The significant ($P \leq 0.05$) rise in DWI with rise in AT (Fig. 1b) was expected. The rise in the time spent drinking was very sharp as AT rose to 28 °C from 26 °C (diurnal period: 09:00 – 12:00 hrs) probably due to more severe thermal stress and the greater need by the rabbits to cool their body. Water serves as a heat sink in the body and enhances insensible (evaporative) heat loss. The temporary drop in time spent drinking observed between 28 – 30 °C AT (diurnal period: 12:00 – 15:00 hrs) could arise from the animals adopting the lying down posture to cool the body via heat conduction, convection and radiation from the body surfaces. However, as AT rose from 30 °C to 32 °C, DWI increased again signifying increasing need for evaporative heat loss. Rabbits have few functional sweat glands (Marai et al*.,* 1991) and fur bearing animals in general loose little heat through their skin due to the covering of fur (Marai et al*.,* 1991). Consequently, evaporative heat loss constitutes the major source of heat dissipation for this class of animal under severe heat stress (Marai et al*.,* 1991; Marai and Rashwan, 2004).

The decline in the time spent standing with rise in AT from 28 °C (Fig. 2a) was sequel to increased thermal stress and the greater tendency to lie down and to drink water. Thus, both the time spent in lying down (Fig. 2b) and drinking water (Fig. 1b) increased sharply with rise in AT to 30 °C and above. Sevi et al*.* (2002) observed that greater percentage of experimental time was allocated to lying down compared to feeding in lactating ewes under low ventilation regimen (higher thermal stress) compared to moderate and programmed ventilation regimens. Duration of standing was less sensitive to changes in AT probably because the standing posture does not significantly enhance body heat loss under severe thermal stress. It has however been reported that in the absence of shade, an animal will change its posture to the vertical position in respect to the sun in order to reduce the effective area for heat gain from solar radiation during periods of high AT (Silanikove, 2000; Hansen, 2004). Sheep and goats tend to crowd, and to stand intimately side by side for the same purpose (Silanikove, 2000).

The significantly longer DWI due to interaction effect of test period x ambient temperature (Table 3) confirm the dependent nature of this trait on AT within each test period. Within the nocturnal period, water intake was not observed within AT range of 21 – 23 °C probably due to inactivity within the time period and/or lack of a need of water for normal physiological processes (e,g. thermoregulation) consequent upon the low AT. DWI was longer at AT range of 27 – 29 °C as was observed in the early nocturnal period (18:00 – 21:00 hrs) (Table 1) sequel to the higher AT and greater thermal stress. The significantly longer duration of lying down at AT range of 21 – 23 °C coincided with the hours of rest and inactivity and lowest AT. The short duration spent lying down at AT range of 27 – 29 °C (early nocturnal period) is explained by the need to drink water to cool the body hence DWI was longest at this AT range. For the diurnal period, all traits except DS differed significantly with AT indicating that the diurnal AT regimen impacted more on the behavioural traits. Duration of feed intake was least at AT ranges of 23 – 25 °C (early diurnal period) and 31 – 32 °C (late diurnal period). For early diurnal period (23 – 25 °C), it could be that the rabbits have just transitioned from the nocturnal period and are still awaiting for fresh supplies of feed or had lesser need for feed at this early diurnal period while for the late diurnal period, the short DFI was sequel to the high AT and cumulative effects of heat stress which discouraged feeding within this period and AT. Moderate ATs (ATs close to the TNZ) are therefore, the best thermal conditions for feed intake in rabbits. The increasing trend observed for DWI following increasing diurnal AT reflect the positive and linear relationship between AT and water intake. Duration of lying down was similar to the trend observed for the nocturnal AT ranges being longest at low and high ATs and lowest at moderate ATs. It does appear that at temperatures close to the TNZ, rabbits lie down only sparingly. However, the need to feed and/or drink at certain time periods may have influenced the durations of some of the behavioural traits.

The significantly positive correlation between DFI and DS, DWI and DS and DWI and AT (Table 4) arose because rabbits generally stand or squat to feed or drink and because water intake increases with AT. Duration of standing and DLD were significantly negatively correlated since both behaviours are mutually exclusive. Duration of lying down was significantly negatively correlated with AT indicating that as AT increases, the tendency to lie down decreases which could arise from the need to stand to drink water to cool the body.

CONCLUSION

Feed and water intakes impact on welfare and performance of rabbits. The present study revealed that AT affects duration of nutrient ingestion and by extension, the amount of total nutrient consumed by rabbits. High ATs discouraged feed intake for most of the diurnal period and rabbits utilized early nocturnal period for feeding. Therefore, rabbits should be provided with feed during the diurnal period as well as for the nocturnal period contrary to the current practice in most rabbit holdings where nocturnal feeding is not seriously considered. Rabbits spend longer time drinking during the diurnal period consequent upon the higher ATs during this period. Therefore intensively reared rabbits should be provided with cool clean water at all times but especially during the diurnal period. Again, to enhance normal activities of rabbits, temperatures within their comfort zone should be ensured.

REFERENCES

Anna M and Lance J (2005). The rabbit. Royal (Dick) School of Veterinary Studies, University of Edimburgh. Available online at www.rabbitcare.com.

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Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Armstrong DV (1994). Heat stress interaction with shade and cooling. Journal of Dairy Science 77: 2044-2050.
Batchelor GR (1991). Group housing on floor pens and environmental enrichment in sandy Lop rabbits. Journal of the Institute of Animal Technology, Sussex 42 (2): 109-120.
Bernabucci U, Lacetera N, Baumgard LH, Rhoads RP, Ronchi B and Nardone A (2010). Metabolic and hormonal acclimation to heat stress in domesticated ruminants. Animal 4(7): 1167-1183.
Carey HV, Andrews MT and Martins SL (2003). Mammalian hibernation: cellular and molecular responses to depressed metabolism and low temperature. Physiological Review 83: 1153-1181.
Dosenbery DB (2009). Living at microscale. Harvard University Press, Cambridge, mass. 448pp.
Fayez MM and Alnaimy MH (2000). Thermoregulation in rabbits. Egyptian J. Anim. Prod. 11: 120- 122.
Finzi A, Morera P and Kuzminsky G (1988). Acclimation and repeatability of thermo tolerance parameters in rabbits. Proceedings of the 4th Congress of the World Rabbit Science Association. Budapest, Hungary, 419-424.
Gates RS, Zulovich JM, Tuner L, Wurm J, Johnson MFG (2001). Potential for heat stress relief using desicant systems in swine breeding facilities. 7th Int. IBPSA Conference Rio de Janeiro, Brazil, August 13-15. pp 789-796.
Hansen PJ (2004). Physiological and cellular adaptations of Zebu cattle to thermal stress. Animal Reproduction Science 82-83: 349-360.
Hansen PJ (2009). Effects of heat stress on mammalian reproduction. Philosophical Transactions of the Royal Society B. 364: 3341-3350.
Horowitz M (2002). From molecular and cellular to integrative heat defence during exposure to chronic heat. Comparative Biochemistry and Physiology Part A 131: 475-483.
James AL and Kim H (2010). Group housing rabbits. Canadian Council on Animal Care publications. Available online at http://www.awionline.org.
Krohn TC, Ritskes-Hoitinga J and Svenden P (2000). The effects of feeding and housing on the behaviour of the laboratory rabbit. J. Royal Society of Medical Laboratory Animal 33: 101-107.
Manteuffel G (2002). Central nervous regulation of the hypothalamic-pituitary-adrenal axis and its impact on fertility, immunity, metabolism and animal welfare – a review. Arch. Tierz., Dummerstorf 45 (6): 575-595.
Marai IFM and Rashwan AA (2004). Rabbits behavioural response to climate and managerial conditions - a review. Arch. Tierz Dummerstorf 47 (5): 469-482.
Marai IFM, Abdel-Samee AM and El-Gafaary MN (1991). Criteria of response and adaptation to high temperature for reproductive and growth traits in rabbits. Options Mediterraneennes 17: 127-134.
Marai IFM, El-Darawany AA, Fadiel A, Abdel-Hafez MAM (2008). Reproductive performance traits as affected by heat stress and its alleviation in Sheep. Tropical and Sibtropical Agroecosystems 8 (3): 209-234.
Marai IFM, Habeeb AAM and Gad AE (2002a). Rabbits' productive, reproductive and physiological performance traits as affected by heat stress – a review. Livestock Production Science 78: 71-90.
Marai S and Nardone A (2010). Dynamics of the temperature – humidity index in the Mediterranean basin. Int. Journal of Biometeorology Doi: 10.1007/s00484-010-03313.
Mathur R (2005). Introduction and Significance of study of Animal Behaviour. In: Mathur R. (ed.). Animal Behaviour 3rd edition: 1-18.
Mayer R and Bucklin R (2009). Influence of hot-humid environment on growth performance and reproduction of swine. Dept. Anim. Sci. Series An 107, University of Florida (IFAS Extension). http://edis.ifas.ufl.edu.
Nedergard J, Cannon B and Jaenicke R (1990). Mammalian Hibernation (and Discussion). Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 326 (1237), Life and Low temperatures: 669-686.
Ogunjimi LAO, Oseni SO and Lasisi F (2008). Influence of temperature-humidity Interaction on heat and moisture production in rabbits. Management and Economy 9th World Rabbit Congress-June 10-13, 2008-Verona-Italy: 1579-1584.
Sevi A, Albenzio M, Annicchiarico G, Caroprese M, Marino R and Taibi L (2002). Effects of ventilation regimen on the welfare and performance of lactating ewes in summer. Journal of Animal Science 80: 2349-2361.
Silanikove N (2000). Effects of heat stress on the welfare of extensively managed domestic ruminants. Livestock Production Science 67: 1-18.
Svotwa, E, Makarau A and Hamudikuwanda H (2007). Heat tolerance of Mashona, Brahma and Simental cattle breeds under warm humid summer conditions of Natural region 11 area of Zimbabwe. Electronic Journal of Environment, Agriculture and Food Chemistry 6 (4): 1934-1944.
Villalobos O, Guillen O and Garcia J (2008). Effect of density on performance of Fattening rabbits under heat stress. Management and Economy 9th World Rabbit Congress June 10-13, Verona-Italy: 1631-1636.

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