Effect of ambient temperature & relative humidity on respiration rate, body temperature and blood pH of newborn lambs during cold conditions

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Abstract: Three different breeds of newborn lambs (Osimi, Rahmani and Suffolk) were used in this experiment. The effects of breed, sex and ambient temperature & relative humidity on body temperature, respiration rate and blood pH of newborn lambs were studied. Obtained results showed that there were significant differences due to differences in ambient temperature and relative humidity in studied parameters. While, breed factor affect significantly only respiration rate as for newborn lambs.

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1. Introduction

Environmental temperature and relative humidity can affect directly physiologically responses of newborn lambs. These effects could be correlated to their impact on body metabolism and body heat production. Immediately, after birth newborn lambs depend on their reservoirs of brown fat for energy production. The newborn lamb should be able to suck ewe udder to obtain colostrum as a fuel for heat production to maintain body temperature for surviving (Dwyer & Morgan, 2006).

To maintain body heat after birth, the lamb must use body energy reserves to generate heat. This energy reserve is mainly brown fat stores laid down in pregnancy (Martin, 1999). In addition the ability to survive is crucially dependent on the response of the lamb to the thermal (climatic) environment into which it is born. Lambs are born, often into cold or wet conditions, with low fat cover and have a high surface area to body weight ratio, which exacerbates heat loss (Alexander, 1970; Stephenson *et al.,* 2001). Histologically, brown adipose tissue (BAT) from newborn mammals differs considerably from white adipose tissue WAT; in particular, the number and size of mitochondria are much greater in the former. The appearance of mitochondria also differs, the cristae being more tightly packed and more numerous (Hahn and Novak, 1975). Studies show that, in the sheep, nonshivering thermogenesis produces 33% of the extra heat in the newborn and 3% in the adult (Alexander and Williams, 1968).

Breed and sex can affect ability of newborn lambs to withstand cold stress. Cold stress is very drastic and dramatic to newborn lambs especially if the birthing occurred nightly near the onset of dawn. Body temperature and respiration rate can take as a good parameter for the cold stress occurrence.

The objective of this work is to find out the effect of ambient temperature, relative humidity, breed and sex on body temperature, respiration rate, and blood pH as an indication for cold stress occurrence of newborn lambs.

2. Material & Methods

Three different breeds (45 Osimi, 51 Rahmani and 14 Suffolk) of newborn lambs at the Experimental Farm of Faculty of Agriculture, Suez Canal University, Ismailia, Egypt, were used in this experiment. Immediately after parturition, lambs were subjected to measurements of body temperature (BT), through rectum orifice by using a medical thermometer. Respiration rate (RR) was estimated by counting number of flank movements of newborn lambs per minute.

Ambient temperature and relative humidity were recorded daily (day and night) in lambs pins during the season of births during the spring season of 2010. A sample of blood was collected from jugular vein to determine blood pH. All estimated parameters were measured three times through experiment period. These three times were at birth, after one week and after two weeks of parturition. Temperature humidity index (THI) was calculated according to the following formula:

Where, T = ambient or dry-bulb temperature in °C and RH=relative humidity expressed as a proportion i.e. 75% humidity is expressed as 0.75.

Data were collected for statistical analysis using general linear model of SPSS 16 Program. The following mathematical model was used in this experiment:

$Y_{ijkl} = \mu + I + j + k + L + e$

Where

Y_{ijkl} = The observation on the i^{th} individual from the j^{th} from the k^{th} from l^{th}

μ = the overall mean

I represents effect of breed J represents effect sex

K represents effect of ambient temperature

L represents effect of relative humidity

e represents experimental error

3. Results and Discussion

Data in Tables 1,2 & 3 represent means of body temperature (BT), respiration rate (RR) and blood pH values as affected by breed, sex and ambient temperature and relative humidity. Analysis of variance (ANOVA test) showed that there were significant differences ($P \leq 0.05$) in measured parameters (BT, RT and blood pH) due to differences in ambient temperature and relative humidity as shown in Table 3. In which fluctuation in ambient temperature and relative humidity caused a severe increasing in respiration rate to become 84.48±3.36 at ambient temperature and relative humidity (19.5□C and 45%) verses 54.85±2.98, 64.89±5.88 and 66.72±2.3 for 20□C&58%, 12□C&54% and 21.5 & 50%, respectively. Also both of body temperature and blood pH were affected significantly ($P \leq 0.05$) by variation in ambient temperature and relative humidity as shown in Table 3. Paim *et al.,* 2014 found that in cold situations lambs tended to lie down and protect front flank temperature point, rear flank temperature point and neck points. Application of THI formula showed no heat stress was observed for these lambs during experiment period as shown in Figure 1. The only adversely environmental factor was lowering ambient temperature overnight which recorded 12□C.during experiment period. Breed factor affected respiration rate significantly as presented in Table1. Means of respiration rate and body temperature were the highest in Rahmani lambs where they reached 70.05±3.12 and 40.33±0.11, for both traits, respectively. While there were no significant differences in body temperature and blood pH due to breed effect. While sex factor has no significant differences as for aforementioned parameters as shown in Table 2.

Ambient temperature can affect body metabolic rate by affecting hormones related to this process (Dauncey, 1990). There is an optimal thermal range to avoid cold stress. Surrounding temperature below 15□C.can adversely affect BMR of newborn lambs. In which lambs cannot face their surrounding decreasing in environmental temperature to adjust their body temperature and respiration rate. This is very obvious from changes in body temperature, reparation rate and blood pH values of newborn lambs in relation to changes in ambient temperature and relative humidity as shown in Table 3. Adequate fat reserves at birth for the lamb are derived from the ewe via the placenta during the last half of pregnancy. Twelve hours or more into life, a lamb is again vulnerable. Soon after birth the heat mechanism was working but now the energy reserves are used up. The lamb is not able to replace these reserves from the ewe; heat production slows and again the lamb becomes hypothermic (Martin, 1999).

This is can put some focus on overnight births which can affect directly body physiological responses such as body temperature, respiration rate and blood pH and can cause injures of cold stress.

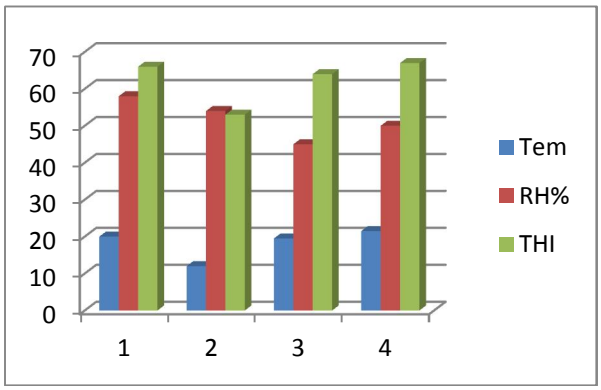

Figure1. Four sets of data represent ambient temperature, relative humidity and temperature humidity index (THI) for each set.

Table 1. Means ± SE of respiration rate RR ,body temperature BT and blood pH of newborn lambs as affected by breed

Breed		RR	BT	Blood pH
Osimi	Mean*	65.0444[b]	40.2319	7.0904
	N	45	45	45
	Std. Error of Mean	2.84338	.11792	.03959
	Minimum	14.00	39.00	6.45
	Maximum	108.00	42.00	7.60
Rahmani	Mean	70.0529[a]	40.3315	7.0749
	N	51	51	51
	Std. Error of Mean	3.12205	.11293	.04333
	Minimum	30.00	38.00	6.40
	Maximum	120.00	42.00	7.96
Suffolk	Mean	66.3333[b]	39.9714	7.0179
	N	14	14	14
	Std. Error of Mean	6.55647	.22322	.09684
	Minimum	30.00	39.00	6.00
	Maximum	108.00	42.00	7.39

Means with different superscript letters differed significantly at $P \leq 0.05$

Table 2. Means ± SE of , respiration rate RR ,body temperature BT and blood pH of newborn lambs as affected by sex.

Sex		RR	BT	Blood pH
Male	Mean	66.8972	40.3137	7.0604
	N	65	65	65
	Std. Error of Mean	2.53946	.09993	.03743
	Minimum	14.00	38.00	6.00
	Maximum	120.00	42.00	7.96
Female	Mean	68.6250	40.1310	7.0981
	N	45	45	45
	Std. Error of Mean	3.43319	.11734	.04261
	Minimum	16.00	39.00	6.55
	Maximum	108.00	42.00	7.60

Table 3. Means ± SE of , respiration rate RR ,body temperature BT and blood pH of newborn lambs as affected by ambient temperature and relative humidity.

Ambient Temp	Relative Humidity%	RR	BT	Blood pH
20	Mean	54.8519^{c}	40.2185^{b}	7.0678^{b}
58	N	27	27	27
	Std. Error of Mean	2.98128	.06040	.04166
	Minimum	16.00	39.50	6.70
	Maximum	84.00	40.80	7.96
12	Mean	64.8947^{bc}	40.2261^{b}	7.0477^{b}
54	N	19	19	19
	Std. Error of Mean	5.87984	.09287	.05631
	Minimum	14.00	39.50	6.00
	Maximum	108.00	41.00	7.40
19.5	Mean	84.4800^{a}	39.5200^{c}	7.4040^{a}
45	N	25	25	25
	Std. Error of Mean	3.35714	.11719	.01829
	Minimum	60.00	38.00	7.23
	Maximum	120.00	40.00	7.60
21.5	Mean	66.7175^{b}	40.7325^{a}	6.8873^{c}
50	N	39	39	39
	Std. Error of Mean	2.99663	.15862	.04606
	Minimum	30.00	39.00	6.40
	Maximum	96.00	42.00	7.58

Means with different superscript letters differed significantly at $P \leq 0.05$

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