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EFFECT OF HOUSING SYSTEM ON SOME PHYSIOLOGICAL RESPONSES OF GROWING BARKI LAMBS

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ABSTRACT

An experiment was carried out on 36 growing Barki lambs to study some physiological responses as affected by two housing systems (semi-closed and closed) in comparing with unshaded one along four successive seasons. The lambs average age and weight were about 6 months and 23 kg respectively at the start of the experiment (winter season). Climatic conditions were recorded simultaneously when measuring physiological traits two times a day at 06.00 and 14.00 h biweekly intervals. The studied physological responses were respiration rate (RR), rectal temperature (RT). Skin temperature (ST), water consumption (W.C.), cell blood counts (RBC and WBC), haematocrit (PCV) and haemoglobin (Hb).

The results obtained showed significant diurnal and seasonal variations for all parameters studied except the diurnal for (Hb). Shaded pens had lower ambient temperature AT (non significant), solar radiation SR (significant) and higher relative humidity RH (significant $P<0.01$) than unshaded pen. The decrease in AT and SR was greater in closed pens than in the semi-closed in comparison with the unshaded. Whereas the increase RH was high in closed pen than semi-closed in comparison with the unshaded. RR, RT and ST were significantly lower under shaded pens during four seasons except ST was high in cold winter season indicating that shading helped in warming the animals RR, RT and ST were significant +ve and –ve correlated with AT and RH respectively.

Closed system imposed heat stress on the animals within, it increased water consumption during hottest periods with larger degree than what occurred in semi-closed than unshaded animals. Generally shading helped in saving W.C. Body weight was not significantly affected by housing types although the animals in the semi-closed had higher body weight than those in the other two types . Shading helped in an significant increase ($P<0.01$) in blood counts, PCV and Hb. Semi-closed system kept WBC at constant and high level than other two pens (closed and unshaded) along the experimental study.

INTRODUCTION

In Egypt, sheep raised mainly in desert i.e. subtropical arid climate, suffer from direct and indirect solar radiation during long hot summer season as well as wind and rain during winter one.

Heat or cold stress well affect thermal balance which reflect changes in heat storage (RT), heat production and/or heat loss (respiratory evaporation). Therefore sheep respond to severe changes in climatic conditions by seeking shelter. Housing design may determine what extent the animals could be protected from extreme climatic variations.

Morand-Fehr (1981) concluded that housing of the kids older than 3-4 months might either be semiopen or closed if well ventilated. Houria (1995) demonstrated that open housing system offered better body performance.

The present work was undertaken to study the relationship between microclimatic condition in two types of houses (semi-closed and closed) with the macroclimate in an unsahded pen along four seasons. Meanwhile, an attempt was therefore made to study the physiological responses of Barki sheep to house system, i.e. respiratory rate, body temperature, water consumption and follow the change in their body weight and measurements of some haematological parameters.

MATERIALS AND METHODS

The present study was carried out at Maryout experimental station of the Desert Research Center (DRC). The experimental animals were thirty six Barki lambs, 6 months old, with 23.02 kg an average body weight of at the start of the experiment. The work was done along the year from winter to autumn (2000).

Housing and management:

Two housing systems, semi-closed and closed pens, were used in this study as compared with unshading pen (control). The latter pen was surrounded by 1.5 m high wall. The covered area of the semi-closed and closed pen made from a kiap covered with plastic sheets. The semi-closed house was provided with open yard enclosed by 1.5 m high wall. The walls of closed and semiclosed pens had have the same height, sides 3.5 m and at the middle 4 meter. The walls in three pens were constructed from cement hollow block. Ventilation in two design systems was provided with windows along the breadth of the walls.

The lambs were equally divided into 3 pens (12 lambs in each). They were fed *ad libitum* on hay and concentrates (undecorticated cotton cake 50%, wheat bran 18%, yellow maize 15%, rice polish 11% molasses 3%, limestone 2% and common salt 1%) the supplementary feeding was adopted to changes in the body weight of the animals along the year of the experiment. Animals were allowed to drink fresh water *ad libitum* twice daily.

Field observations and physiological parameters:

Ambient temperature and relative humidity were measured using a hair hygrometer provided with centigrade thermometer. Solar radiation was measured using a bulb made of copper that was painted in black (16 cm diameter) provided with a thermometer. These physical parameters were recorded biweekly at 6.00 and 14.00 h. Skin temperature (ST) was recorded using a digital electronic tele thermometer and rectal temperature (RT) was measured using a standard clinical thermometer. The ST and RT were measured according to McCaffrey (1979). Respiration rate (RR) was recorded by counting the flank movement in one minute according to Kawashti (1968). These parameters were also recorded biweekly at 06.0 and 14.00 h (at the same days of recording physical climatic conditions).

Water consumption was determined for each animal (Litre/head/day). Blood samples were collected from 6 animals in each group from the jugular vein in heparinised tubes at 06.00 and 14.00 h at biweekly intervals. Heparenised blood was used for determination of blood cell counts according to the method of Dacie and Lewis (1984). Haemoglobin concentration was determined according to the method of Drabkin and Harold (1932). The haematocrit percentage was determined according to the method of Wintrob (1961).

Statistical analysis:

Data of the physiological parameters were statistically analysed using Model GLM of SAS software version (6 12) (SAS 1996). Duncan multiple range test was used to test the level of significance among the means (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSIONS

1. Meteorological data:

There were significant (P<0.01) increase in both ambient temperature (AT) and solar radiation (SR) and significant (P<0.01) decrease in relative humidity (RH) from 6.00 to 14.00 h during the day (Table 1). On the other side,. A gradual increase among the successive seasons for the values of the AT. and SR which were significant (P<0.05) form winter to summer as shown in Fig (1) , and tended to decrease significantly (P<0.05) from summer to autumn. With respect to RH Fig. (1) exhibits its significant (P<0.05) decrease from winter to spring then its significant increase in summer followed by significant decrease again in autumn season. Generally the highest values of AT, SR and RH as overall means were recorded in summer season, so the latter season might be considered hot humid season. Whereas the lowest values for both AT and SR in winter and for RH in spring. These findings were partly in agreement with those of Ashour *et al.* (1998).

Animals in the semiarid region suffer from severe climatic conditions during hot mid-day summer. It may be worthy to notice that housing system in the present study exhibited reduction in both AT (non significant) and SR (significant (P<0.01) about 7.33° at mid day summer than those under unshaded pen (control).This suggest that the building elements of the housing induce lowering AT and SR. Azamel *et al.* (1987) pointed to that asbestos shading reduced ambient temperature by about 10°C at mid-day summer. Yousef *et al.* (1997) found wood shed decreased AT by about 5 °C as compared to unshaded pen in summer season. Khalifa *et al.* (2000) registered AT 34.5C° under shade and 40.0 C° under direct solar radiation. Unlikely the present shading pens induced significantly (P<o.o1) a rise in RH inside which was considered as a defect for shading.

The decease in AT and SR at 14.00 h under shaded (semi-closed and closed) pens than that in the unshaded one was greater in closed one which, in the same time, had higher RH than in the semi-closed one, this may be due to the exposure of the semi-closed pen to sunshine. It can be seen that

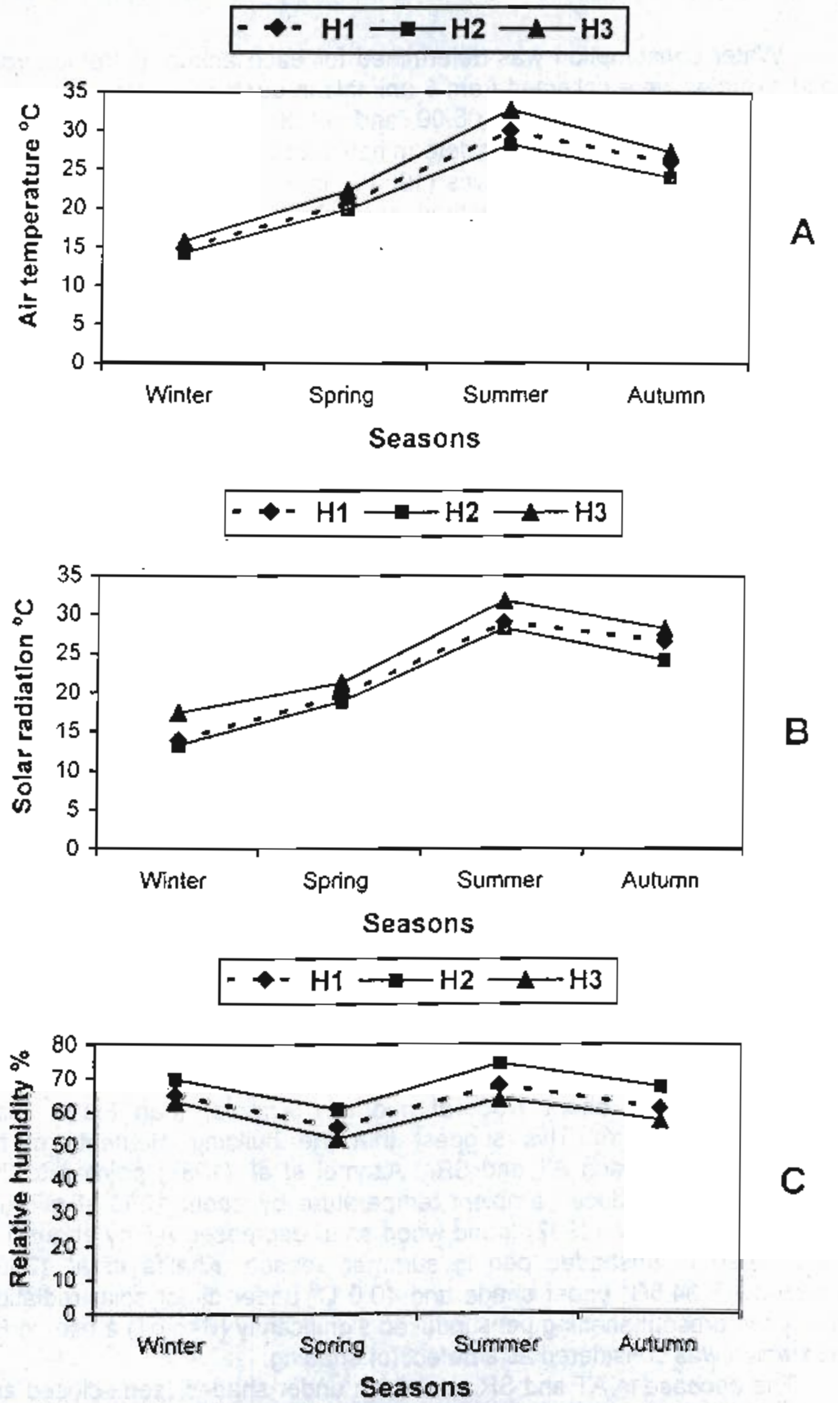


Fig. (1): Effect of housing and seasons on air temperature (A), solar radiation (B) and relative humidity (C).
H1: Semi-closed H2: Closed H3: Unshaded

the moderate values of climatic parameters were observed inside the semi-closed pen along the year, therefore offered profitable life for the animals within.

Table (1) : Averaged ± SE of ambient temperature (At, °C), solar radiation (SR,°C) and relative humidity (RH%) in different houses through the experimental period.

Season	Winter		Spring		Summer		Autumn		Overall mean
Time	6	14	6	14	6	14	6	14	
At									
H1	11.33 ±0.62	18.41 ±0.60	13.5 ±0.66	28.08 ±0.66	24.75 ±0.68	35.33 ±0.68	20.33 ±0.62	31.58 ±0.62	28.8±0.31
H2	11.16 ±0.60	17.41 ±0.62	13.33 ±0.62	26.58 ±0.60	25.00 ±0.67	31.50 ±0.68	20.75 ±0.68	27.41 ±0.66	21.5±0.31
H3	10.91 ±0.68	20.58 ±0.62	13.58 ±0.66	31.08 ±0.68	24.66 ±0.68	40.75 ±0.66	20.33 ±0.66	34.33 ±0.66	24.5±0.31
Overall mean	14.9^d±0.24		21.0^c±0.24		30.3^a±0.24		25.7^b±0.24		
SR									
H1	10.33 ±0.67	17.41 ±0.60	12.50 ±0.66	27.08 ±0.62	23.75 ±0.61	34.33 ±0.68	19.33 ±0.62	34.30 ±0.68	22.3^b±0.12
H2	10.16 ±0.66	16.41 ±0.67	12.33 ±0.68	25.58 ±0.61	24.00 ±0.60	32.50 ±0.62	19.75 ±0.62	28.66 ±0.60	21.1^c±0.12
H3	9.91 ±0.61	25.00 ±0.61	12.58 ±0.61	30.08 ±0.67	23.66 ±0.61	39.75 ±0.60	19.33 ±0.68	37.25 ±0.60	24.6^a±0.12
Overall mean	14.8^d±0.24		20.0^c±0.24		29.6^a±0.24		26.3^b±0.24		
RH									
H1	78.08 ±1.60	52.08 ±1.60	68.25 ±1.64	42.83 ±1.61	85.33 ±1.62	50.75 ±1.60	75.50 ±1.62	46.91 ±1.60	62.4^b±1.02
H2	77.58 ±1.62	61.83 ±1.60	72.91 ±1.62	48.83 ±1.61	89.50 ±1.62	59.58 ±1.62	79.66 ±1.60	55.66 ±1.62	67.7^a±1.02
H3	75.16 ±1.62	50.85 ±1.61	63.91 ±1.66	40.08 ±1.62	82.50 ±1.60	45.25 ±1.61	73.41 ±1.62	41.66 ±1.62	56.2^c±1.02
Overall mean	65.9^b±0.66		56.1^d±0.66		68.8^a±0.66		62.1^c±0.66		

SE: Standard error H1: Semi-closed H2: Closed H3: Unshaded
Averages with different letters (a,b,c,d) are significantly different at P<0.05.

2. Physiological rsponses:

In all studied groups a highly significant (P<0.01) increase in respiration rate (RR), rectal temperature (R,T) and skin temperature (ST) from 06.00 to 14.00h were observed as shown in Table (2). This diurnal rise is partly due to cyclic rhythm in biological activities and partly due to increase in air temperature at mid day. The present findings pertained with diurnal variation are in a good agreement with those obtained by Shalaby and Johnson (1993), Sayah (1997) and Ashour *et al.* (1998). Fig. (2) denotes a significant (P<0.05) gradual increase in these parameters from winter to summer seasons and then significant (P<0.05) decrease from summer to autumn disclosing their highest values in summer season. Thus, the experimental animals were considered heat stressed at mid-day in summer.

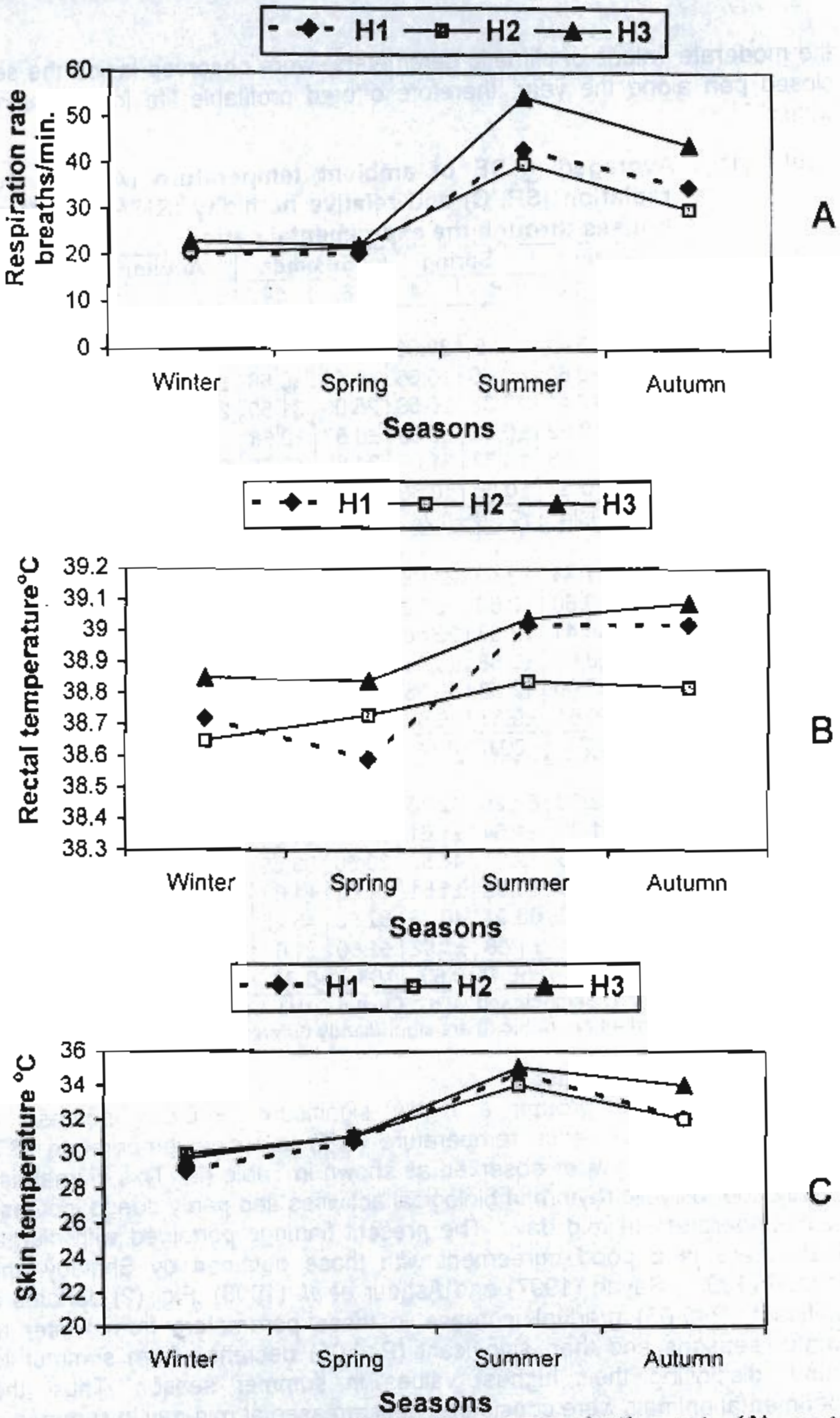


Fig. (2): Effect of housing and seasons on respiration rate (A), rectal temperature (B) and skin temperature (C) of lambs.

H1: Semi-closed H2: Closed H3: Unshaded

Table (2): Averages of respiration rate (RR) breaths/min, rectal temperature RT, C° and skin temperature ST C° for the animals in different pens along the experimental period.

Season	Winter		Spring		Summer		Autumn		Overall mean
Time	6	14	6	14	6	14	6	14	
RR									
H1	14.00 ±1.29	26 91 ±1.27	10.83 ±1.27	30.08 ±1 28	29.00 ±1.26	57.50 ±1.27	15 58 ±1.29	54.50 ±1.29	29.80^{b}±0 45
H2	13.16 ±1.26	28.30 ±1.27	14 50 ±1.29	29.00 ±1.25	32 00 ±1.29	48.41 ±1.29	20.00 ±1.27	40.58 ±1.29	28.20^{c}±0 45
H3	16.41 ±1.28	31.00 ±1.29	11.25 ±1.28	33.25 ±1.29	31.33 ±1.25	78.00 ±1.28	18.75 ±1.28	69.83 ±1.29	36.23^{a}±0.45
Overall mean	21.63^{c}+0.53		21.48^{c}+0.53		46.05^{a}+0.53		36.54^{b}+0.53		
RT									
H1	38.35 ±0.02	39.09 ±0.09	38.30 ±0.07	38.88 ±0.05	38.62 ±0.06	39.41 ±0.08	38.60 ±0.06	39.45 ±0.06	38.84^{b}±0.02
H2	38.34 ±0.05	38.97 ±0.07	38.52 ±0.04	38.94 ±0.05	38.63 ±0.07	39.05 ±0.07	38.49 ±0.07	39.15 ±0.08	38.70^{b}±0.02
H3	38.43 ±0.05	39.28 ±0.04	38.54 ±0.05	39.14 ±0.05	39.03 ±0.07	39.85 ±0.07	38.84 ±0.07	39.34 ±0.08	39.05^{a}±0.02
Overall mean	38.74^{c}+0.03		38.72^{c}+0.03		39.1^{a}+0.03		38.98^{b}+0.03		
ST									
H1	25.99 ±0.37	32.123 ±0.36	29.66 ±0.36	31.78 ±0.39	32.75 ±0.37	36.75 ±0.38	29.72 ±0.36	35.50 ±0.36	31.78^{b}±0.13
H2	28.08 ±0.35	32.22 ±0.38	30.41 ±0.38	31.84 ±0.38	32.42 ±0.39	36.08 ±0.38	29.91 ±0.38	34.67 ±0.38	31.95^{b}±0.13
H3	25.21 ±0.38	34.28 ±0.38	28.58 ±0.38	34.56 ±0.38	34.00 ±0.39	37.42 ±0.38	30.98 ±0.39	37.26 ±0.37	32.71^{a}±0.13
Overall mean	29.65^{d}+0.15		31.10^{c}+0.15		34.9^{a}+0.15		33.01^{b}+0.15		

SE: Standard error H1: Semi-closed H2: Closed H3: Unshaded
Averages with different letters (a,b,c,d) are significantly different at P<0.05.

The difference between the overall means of RR in winter (21.63) and summer (46.05) breaths/min may reveal the higher respiratory efforts was exerted by the animals for thermoregulation. It may be worthy to explain that heat load on the animal leads to rise body temperature which in turn activates the hypothalamus to stimulate the respiratory center and induce an increase in respiration rate to elevate the evaporative heat dissipation. These findings exhibited the role of central and peripheral receptors in the regulation of heat loss. When animals are exposed to a hot environment, their cutaneaous moisture decline, peripheral blood flow and respiratory activity increase as a result of change in the activity of receptors in the skin. If the environment is very hot however the deep body temperature will increase and the increase in the temperature of the hypothalamus will result in further increases in heat loss (Whittow , 1970). Tutida *et al.*, (1999) concluded that the respiratory tract is the main mechanism used by some breeds of rams in Brazil to dissipate heat. Fig (2) shows rise in RR, RT and ST by largest degrees from spring to summer compatible with what occurred in AT and SR in that period Fig (1). These findings were in agreement with those of Shalaby and Johanson (1993), Shafie *et al.* (1994), Hassanien *et al.* (1996) and Ashour *et al.* (1998).

El-Nouty *et al.* (1990) they reported the rise in maximum AT from 24.8 °C in the spring to 35.8 °C in summer caused significant rise in RR of goats by 62%. It is worthy to notice from Fig (2) the steady state in RT for the animals in the closed system among successive seasons may be due to tightly enclosure of this pen which helped in keeping their RT at constant level.

The daily increase in RR, RT and ST from 06.00 to 14.00 h (hottest day time) and their largely increment from spring (mild temperature) to summer (hottest season) took place by small degree under shaded pens than what occurred under unshaded one. So, shading might save the animal from heat stress at mid day summer. The lambs housed in shaded pens showed a significant ($P < 0.01$) decrease in RR, RT and ST (particularly at 14.00 h) than those left unshaded (Table 2). These findings partly agree with Marai *et al.* (1992) on sheep and Thiagarajan and Thomas (1992) on cows. Hassanin *et al.* (1996) concluded that providing an asbestos shed for growing Barki rams under Egyptian summer condition will not protect the animals from hyperthermia by day and night.

In comparing different housing systems, Nema *et al.*, (1997) found that respiration rate and body temperature of calves were highest under the loose housing system than other two systems (shaded and loose house with *ad libtum* water supply). Yousef *et al.* (1997) found wood roofed shed in summer decreased significantly RT and RR of calves. Yazdani and Gupta (2000) recorded that calves kept in loose houses had higher ($P<0.005$) RR than those kept in thatch house. Mitlohner *et al.*, (2001) recorded RR of shaded heifers was lower than that of unshaded one but their RT did not differ among treatments. It may be worthy to notice that, the shaded animals had lower ST than those in the control pen in all seasons except in winter, when they had higher ST as compared to unshaded one indicating that shading process helped in warming the animals in the coldest season. Therefore, the housing system was more of benefit for the animals not only during hottest season but also in coldest one.

The correlation coefficient of RR, RT and ST with AT and SR were significantly +ve and with RH were significantly –ve as shown in Table (3). These findings agree with results of Ashour *et al.* (1998).

Table (3) Phenotypic correlation between air temperature (At) and relative humidity (RH) and some physiological responses (RR, RT and ST).

Parameter	Mean of squares	
	At	RH
At		-0.2
Respiration rate (RR)	0.80***	-0.54***
Rectal temperature (RT)	0.67**	-0.055***
Skin temperature (ST)	0.78***	-0.49***

** = P<0.01   *** = P<0.001

Water consumption:

Table (4) shows significant ($P<0.01$) highest and lowest water consumption in summer and winter seasons respectively. The largest increase of AT from spring to summer season (Fig. 1) induced the animals to increase their water intake by larger degrees among succssive seasons. Fig. (3) exhibits the animals in closed pen in particular increased their water intake in this period by about 111% largest than what occurred in the other two pens semi-closed and unshaded (76.3% and 87.4% respectively). This finding may be due to the tightly enclosure system in the closed pen as mentioned before which induce the animals to increase their water cosumption This finding may be due to that animals kept in closed system were subjected to greater heat radiation from the walls of the house after sunset. Therefore Borady *et al.*, (1984) found the animals kept in closed pens increased their RT at the lower AT (37-40C°) whereas those kept outdoor or in the semi-open elevated their RT when AT rose from (40-45C°). This pointed to closed system caused heat load on the animals under hot condition. Therefore, the semi-closed system proved to be the most favourable as it increased water consumption of the animals in this period by lowest degree. Stephenson *et al.* (1980), Johnson *et al.* (1987), Abdalla *et al.* (1993) and Baccari *et al.*, (1997)recorded that heat stressed animals have greater values for water intake.

Table (4): Averages $\pm$ SE of water consumption (L/ head /day) for the animals in different houses across successive seasons.

Season Housing	Winter	Spring	Summer	Autumn	Overall mean
H1	1.24$\pm$ 0.09	1.94$\pm$ 0.09	3.42$\pm$0.09	2.02$\pm$0.09	2.16$^{b}\pm$0.09
H2	1.14$\pm$ 0.08	1.74$\pm$ 0.08	3.67$\pm$0.08	1.59$\pm$0.08	2.03$^{b}\pm$0.08
H3	1.76$\pm$ 0.08	2.31$\pm$ 0.08	4.33$\pm$0.08	2.96$\pm$0.08	2.84$^{a}\pm$0.08
Overall mean	1.38$^{d}\pm$0.05	1.99$^{c}\pm$0.05	3.81$^{a}\pm$0.05	2.19$^{b}\pm$0.05	

SE: Standard error H1: Semi-closed H2: Closed H3: Unshaded
Averages with different letters (a,b,c,d) are significantly different at P<0.05.

Generally, it was found that shading significantly (P<0.01) helped in saving water consumption as shown in Table (4), when animals consumed lowest amounts of water than that consumed by unshaded ones. These results are in accordance with reports of Mokhtar *et al.*, (1989), Hamed (1991) and Gawish (1998) in their studies on ewes and Ibrahim (2001) on camels.

Haematological parameters:

1. Blood counts (RBC and WBC).

The results obtained proved that RBC were significantly (P<0.01) affected by heat and cold stress as being lower in summer afternoon and winter season, respectively (Table 5). On the other hand, its highest levels were recorded in the morning and mild temperature seasons (spring and autumn). So, the higher values of RBC have been found to be associated with improvement in AT, therefore in comparing shaded and unshaded pen, it can be noticed that shaded animals had significantly higher levels of RBCs

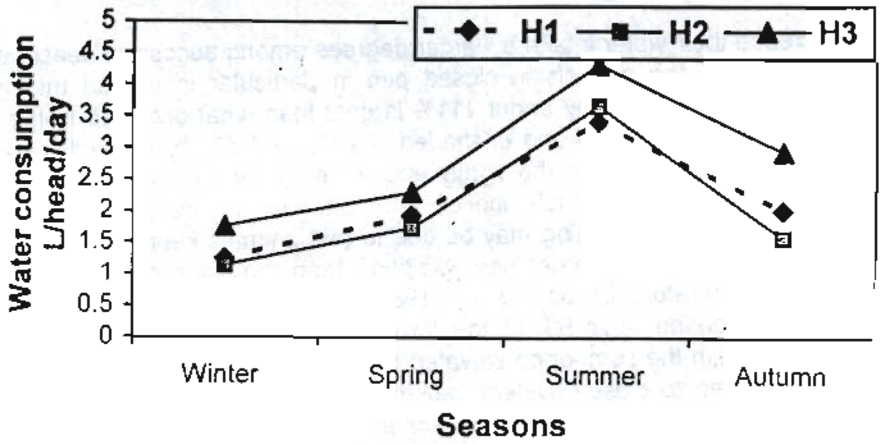
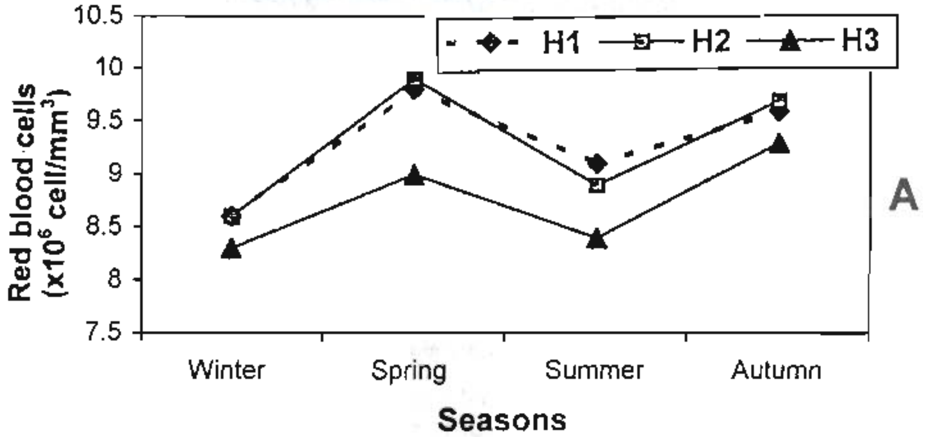


Fig. (3): Effect of housing and seasons on water consumption of lambs.
H1: Semi-closed H2: Closed H3: Unshaded



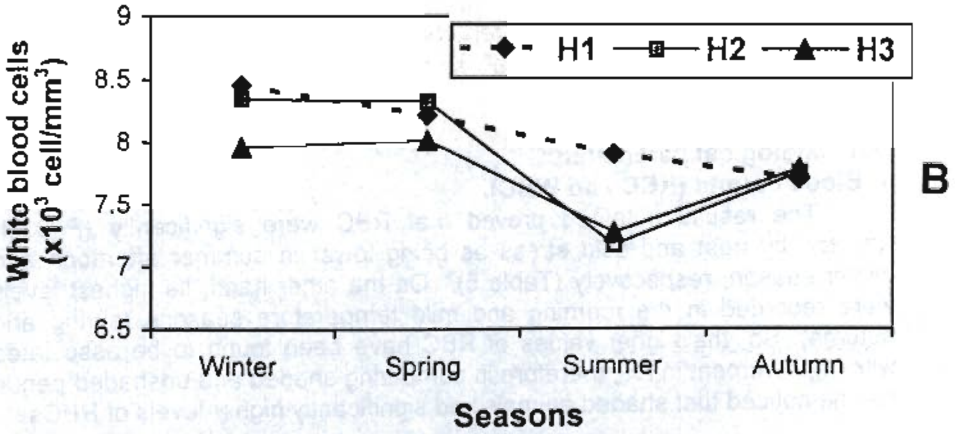


Fig. (4): Effect of housing and seasons on red blood cells (A) and white blood cells (B) of lambs
H1: Semi-closed H2: Closed H3: Unshaded

than unshaded ones. This may be due to the improve in the respiration efficiency in terms of supply of oxygen and removal of carbon dioxide This denoted that shading keep the animals from harmful effect of cold and heat stress. Moderate water consumption by the shaded animals during summer which may saved them from haemodilution and hence an increase in RBC counts was observed.

Table (5) : Haematological parameters (RBC, WBC, PCV and Hb) as average ± SE during the whole experimental period..

Season	Winter		Spring		Summer		Autumn		Overall mean
Time	6	14	6	14	6	14	6	14	
RBC									
H1	8.85 ±0.10	8.47 ±0.11	9.99 ±0.11	9.67 ±0.12	9.22 ±0.14	8.97 ±0.11	9.80 ±0.11	9.57 ±0.12	$9.32^{a}\pm0.04$
H2	8.67 ±0.12	8.63 ±0.11	9.89 ±0.11	9.91 ±0.14	8.03 ±0.12	8.87 ±0.12	9.65 ±0.11	9.83 ±0.12	$9.34^{a}\pm0.04$
H3	8.58 ±0.11	8.16 ±0.11	9.00 ±0.13	9.00 ±0.11	8.58 ±0.11	8.38 ±0.11	9.30 ±0.10	9.43 ±0.14	$8.80^{b}\pm0.04$
Overall mean	$8.5^{c}+0.04$		$9.5^{a}+0.04$		$8.80^{b}+0.04$		$9.60^{a}+0.04$		
WBC									
H1	8.02 ±0.24	8.89 ±0.20	7.93 ±0.22	8.50 ±0.20	8.01 ±0.23	7.85 ±0.23	7.61 ±0.22	7.90 ±0.21	$8.09^{a}\pm0.07$
H2	8.29 ±0.21	8.40 ±0.22	8.31 ±0.21	8.32 ±0.23	7.30 ±0.21	7.05 ±0.20	7.33 ±0.20	8.16 ±0.21	$7.80^{b}\pm0.07$
H3	7.97 ±0.21	7.95 ±0.23	7.89 ±0.21	8.14 ±0.21	7.16 ±0.21	7.39 ±0.21	7.68 ±0.23	7.89 ±0.21	$7.76^{b}\pm0.07$
Overall mean	$8.25^{a}\pm0.07$		$8.18^{a}+0.07$		$7.46^{c}+0.07$		$7.76^{b}+0.07$		
PCV									
H1	35.24 ±0.22	34.27 ±0.25	36.56 ±0.23	36.36 ±0.22	32.58 ±0.24	32.70 ±0.27	34.30 ±0.22	34.10 ±0.23	$34.5^{a}\pm0.08$
H2	35.58 ±0.23	35.47 ±0.22	35.95 ±0.21	35.85 ±0.23	33.25 ±0.23	33.16 ±0.28	34.10 ±0.24	34.25 ±0.23	$34.7^{a}\pm0.08$
H3	33.75 ±0.21	31.92 ±0.23	34.94 ±0.23	34.50 ±0.24	31.60 ±0.24	31.40 ±0.25	33.19 ±0.20	32.66 ±0.23	$32.9^{b}\pm0.08$
Overall mean	$34.38^{b}+0.09$		$35.69^{a}+0.09$		$32.40^{d}+0.09$		$33.70^{c}+0.09$		
Hb									
H1	11.25 ±0.12	11.14 ±0.11	13.58 ±0.10	13.45 ±0.12	12.45 ±0.13	12.37 ±0.12	12.71 ±0.11	12.75 ±0.11	$12.40^{b}\pm0.04$
H2	11.25 ±0.12	11.20 ±0.13	13.411 ±0.10	13.55 ±0.12	12.50 ±0.11	12.40 ±0.11	13.00 ±0.12	13.32 ±0.11	$12.50^{a}\pm0.04$
H3	10.81 ±0.11	10.57 ±0.14	13.08 ±0.12	13.03 ±0.10	11.57 ±0.11	11.26 ±0.10	12.40 ±0.10	12.38 ±0.14	$11.80^{c}\pm0.04$
Overall mean	$11.04^{d}+0.04$		$13.35^{a}+0.04$		$12.09^{c}+0.04$		$12.76^{b}+0.04$		

SE: Standard error H1: Semi-closed H2: Closed H3: Unshaded

Averages with different letters (a,b,c,d) are significantly different at $P<0.05$.

With respect to WBC, Fig (4) shows that animals in the unshaded and the closed pens sharply decreased their WBC levels during abruptly increase AT from spring to hot summer season indicating more sensitive to heat stress imposed by two pens. Whittow (1970) found when the animals became hyperthermic increases accurred in both adrenaline and noradrenaline which in turn affect on the formation of lymphocytes and eosinophils as reported by coles (1974) in domestic animals . Moreover , Assad *et al.*, (1997) found that WBSc. Count changed as a result of changes in lymphocytes and eosinophils count. The causes of leucopenia are the depression of the blood forming elements and/or destruction or degeneration of these cells as a result of chemical or physical agents (Embert & Coles, 1977). Whereas the semi-closed pen keep WBC of the animals within at constant and high level than other two groups among successive seasons. So it can be noticed that the semi-closed system permit free moving for the animals and help them to escape during unlikely climatic conditions. El Sherif (1991), Azamel *et al.*(1992) and Abd El Khalek (2002) reported decrease in blood counts under heat stress.

Haematocrit (PCV) and Haemoglobin (Hb)

PCV exhibited its lowest value in summer afternoon (Table 5). A sharply increase in AT from spring to summer season caused abruptly reduction in PCV to minimum value (Fig 5) explaining –ve highly significant correlation with AT (Table 3). Kawashti and Ghanem (1967) found that PCV tended to decrease during warmer months due to simultaneous increase in water consumption to replinish the evaporative water loss which may cause actual dilution of the blood. Similar reports were obtained by Ashour *et al.* (1998), Ibrahim (2001) and Abd El Khalek (2002). With respect to (Hb), its significant highest and lowest values were recorded in spring and autumn, respectively. Samak *et al.* (1986) recorded significant lower value of Hb for sheep and goats in spring than in summer and winter season. Barghout *et al.*, (1995) recorded negative correlation between HB in goats with air temperature.

Shading helped in significant ($P<0.01$) increase PCV and Hb values of the animals than those under unshaded one (Fig. 5). It can be seen that the higher PCV reflects higher values of erythrocytes counts as shown before. Azamel *et al.* (1984) reported that shading improve animal feeding consequently enhance their PCV value. Samak *et al.*, (1986) found that erythrocyte counts and PCV decreaed during hot summer attributed to a decrease in circulating erythrocytes which has been suggested to be due to an increased rate of erythrocyte destruction. Hamed (1991) and El Sherif *et al.* (1996) pointed to improved haemoglobin content of shaded sheep. Sergent *et al.* (1985), Hassanin *et al.* (1996), Badaway *et al.* (1999) and Shaker (2003) recorded increase PCV and Hb of shaded goats comparing to unshaded ones. The present study revealed that higher levels of blood counts, PCV and Hb enables the animals to withstand the stress imposd by climatic conditions.

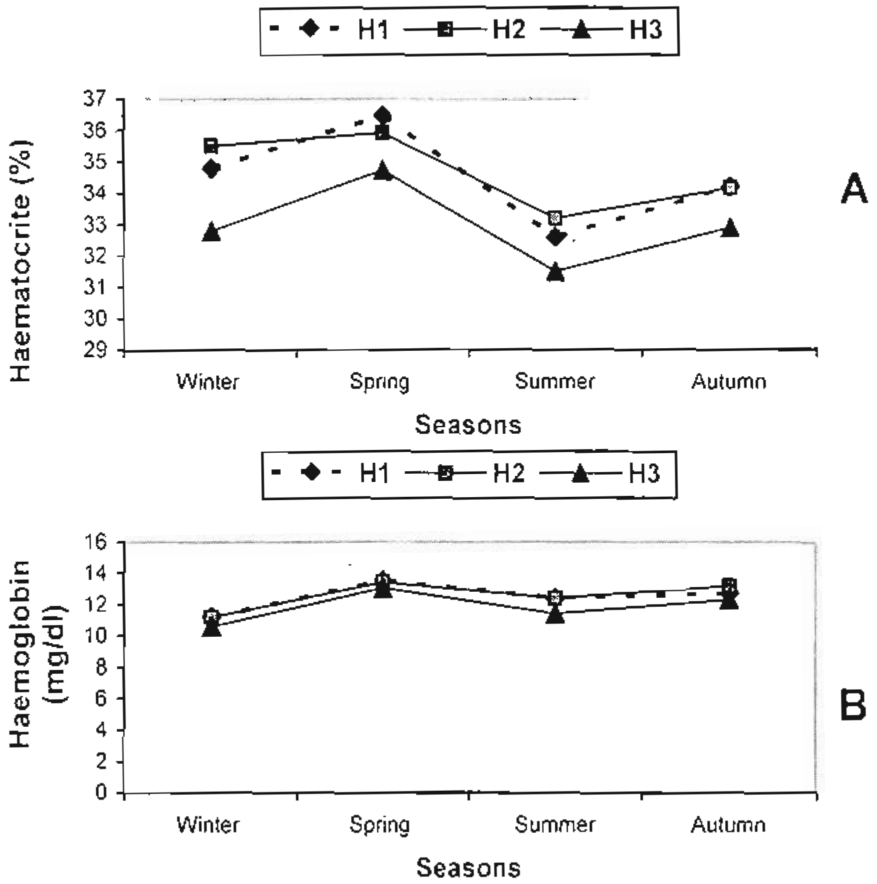


Fig. (5): Effect of housing and seasons on haematocrite (A and haemoglobin (B) of lambs
H1: Semi-closed H2: Closed H3: Unshaded

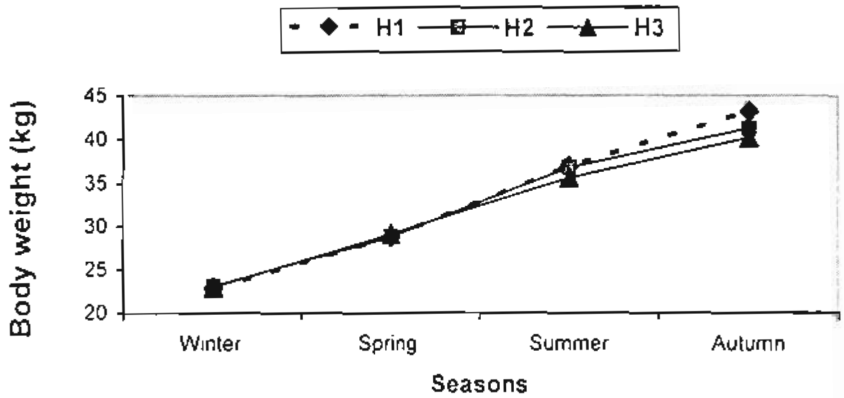


Fig. (6): Effect of housing and seasons on body weight of lambs.
H1: Semi-closed H2: Closed H3: Unshaded

Body weight:

An increase in body weight (the animals in growth rate) took place from starting of the experiment (winter season) till the end of the study (autumn one) as shown in Fig. (6).

Table (6): **Averages ± SE of body weight (kg) of lambs.**

Housing Season	Winter	Spring	Summer	Autumn	Overall mean
H1	22.86 ±0.66	28.74 ±0.66	36.92 ±0.66	43.17 ±0.66	32.92[a] ±0.34
H2	23.15 ±0.64	28.73 ±0.64	36.79 ±0.64	41.24 ±0.64	32.47[ab] ±0.32
H3	23.00 ±0.64	29.07 ±0.64	35.58 ±0.64	40.19 ±0.64	31.97[b] ±0.32
Overall mean	23.02[a] ±0.38	28.84[c] ±0.38	36.43[b] ±0.38	41.53[a] ±0.38	

SE: Standard error H1: Semi-closed H2: Closed H3: Unshaded
Averages with different letters (a,b,c,d) are significantly different at P<0.05.

Table (6) shows average body weight of the animals differed non significantly among different houses, although the shaded lambs, particularly semiclosed, had higher body weight than the unshaded one. Habeeb et al., (1992) referred to feed cmsumption goes down as temperature increases and there is an optimum temperature (24C°) at which gain is best. And they recorded that the high level of cortisol which was observed in the heat stressed calves may be responsible for the depression of its daily gain. Therefore, the present shading particularly (semi-closed) which improved the climatic condition may be increased the metabolic rate associated with higher body weight gain in compared to those exposed to direct sun light . This concurs with that of Azamel *et al.* (1987). Bell *et al.* (1989) found that ewes fed under shade weighed 40% more than those on pasture. Hamed (1991) recorded that proper housing models decrease thermal stress and help in an increasing the productivity of animals. Therefore, Patel *et al.* (1995) reported the benefit derived from any pattern of animal house is judgment through feed utilization by the animals. Yousef *et al.*, (1997) found that cattle housed in wooden roofed shade had higher body weight gain (bwg) than that in concrete shade which in turn had higher (bwg) as compared to cattle exposed directly to solar radiation .

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تأثير نظم الاسكان على بعض الاستجابات الفسيولوجية للحملان البرقى النامية

تم اجراء هذه التجربة على ٣٦ من الحملان البرقى النامية لدراسة الاستجابات الفسيولوجية تحت تأثير نظامين من المساكن (النصف مغلقة والمغلقة) ومقارنتها بالنظام المفتوح على مدار العام .

كان متوسط عمر ووزن الحملان عند بداية التجربة (فصل الشتاء) ٦ أشهر و ٢٣ كجم على الترتيب وقد ، سجلت الظروف المناخية مرتين فى اليوم الساعة ٦ صباحاً و ٢ ظهراً كل اسبوعين بجانب قياس الصفات الفسيولوجية على الحيوان فى نفس الوقت وتشمل معدل التنفس، درجة حرارة المستقيم، درجة حرارة الجلد، الماء المستهلك للشرب وعد خلايا الدم الحمراء والبيضاء والهيموجلوبين والهيماتوكريت مع وزن الحيوانات مرة كل اسبوعين.

أظهرت النتائج اختلافات معنوية يومية وموسمية لجميع القياسات المدروسة عدا التغيراليومى للهيموجلوبين.

كما انخفضت درجة حرارة الجو (غيرمعنوى) والاشعاع الشمسى (معنوى) وارتفعت درجة الرطوبة النسبة (معنويا) داخل الحظائر المظللة عنها عن الحظيرة المكشوفة (الضابطة)، وكان هذا الأختلاف بصورة أكبر فى الحظيرة المغلقة.

انخفض معدل التنفس ودرجة حرارة كلا من المستقيم والجلد بدرجة ذات مغزى احصائى فى الحظائر المظللة عنها فى الحظيرة المكشوفة فى خلال فصول السنة عدا درجة حرارة الجلد فى فصل الشتاء التى ارتفعت مؤدية الى تدفئة الحيوانات . كما وجد ارتباط معنوى موجب وسالب وبين هذه المقاييس الفسيولوجية ودرجة حرارة الجو والرطوبة النسبية على التوالى.

أدى النظام المغلق الى زيادة كمية مياه الشرب فى الفترات ذات درجة الحرارة المرتفعة بصورة أكبر عنه فى النظام النصف مغلق ، والتى كان استهلاك مياه الشرب فيها تم بصورة منخفضة وذات مغزى احصائى عما حدث فى الحظيرة المكشوفة ، لم يتأثر وزن جسم الحيوانات بالمسكن بصورة معنوية .

أدى التظليل الى زيادة عدد كرات الدم الحمراء والبيضاء والهيماتوكريت والهيموجلوبين بدرجة ذات مغزى احصائى وكان للحظيرة النصف مغلقة تأثير واضح على زيادة عدد كرات الدم البيضاء والمحافظة على ثباتها خلال فترة التجربة.