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Heat Tolerance of Saidi Sheep in Relation to Wool Shearing and Some Wool Traits

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FIFTY eight dry adult Saidi ewes of mixed age were used to examine their tolerance to heat stress as affected by shearing and certain wool traits. In response to 6-hour exposure to sun, ewes showed significant ($P' < 0.01$) rises in rectal, skin and coat temperatures (0.65, 1.85 and 3.67 °C, respecitvely) and in respiration rate (15 breaths/min).

As indicated by rectal temperature, the unshorn ewes were significantly ($P < 0.01$) more tolerant to heat than the shorn ewes (39.66 vs 39.96 °C). However, respiration rate and skin temperature were slightly higher for unshorn than shorn ewes (41.9 vs 39.6 breaths/min, and 38.89 vs 38.68 °C, respectively).

Greasy fleece weight significantly ($P < 0.01$) correlated with the changes in both skin temperature ($r = 0.53$) and coat temperature ($r = -0.49$). Staple length and change in skin temperature were significantly correlated ($r = -0.50$). Correlation of fibre diameter with changes in all parameters studied were non-significant. Correlation of rectal temperature or respiration rate with any of wool traits studied were of low magnitude.

Keywords: Heat tolerance, Wool shearing, Solar radiation

In upper Egypt, the long thin-tailed Saidi sheep have been faced with high ambient temperature, intensive solar radiation, high aridity and subsequently poor natural vegetation. Duration and severity of these environmental constraints are more pronounced than elsewhere of Egyptian deserts. For instance, mean maximum ambient temperature may reach over 50°C at midday in summer.

Homeothermy of sheep depends on some morphological and physiological means which enable them to sustain the equilibrium between heat production and heat loss under different thermal conditions. In severe cases, animal's body may receive an excessive heat income from a hottest environment as it is in upper Egypt. In this respect, wool of sheep directly or/and indirectly affects animal-environment heat exchange rate. Wool cover, in general, provides sheep with microclimate which is responsible for their distribution over a wide ecological range (Terrill, 1968). Removal of the fleece, particularly under direct sun is the simplest procedure to prove its protective function for sheep.

A Saidi sheep has a relatively light - mature body weight, dark-coloured fleece covering its whole body, long feet and longbroad ears. However, rather lesser attention has been given to Saidi sheep as compared to other local breeds. This paper examines some thermal reactions of shorn and unshorn Saidi ewes as exposed to direct sun for 6 hours daily in summer. Some wool traits were also studied in relation to heat tolerance of the experimental animals.

Material and Methods

Animals

Fifty eight dry adult Saidi ewes of different ages (2-5 years) were used to study the effect of shearing on their heat tolerance in relation to some wool characteristics. These animals were a part of the flock of Garf Hussein Experimental Station located at the west shore of Nasser Lake, 150 kilometers to south of Aswan (23°N latitude). Animals were allowed to graze natural vegetation and supplemented with concentrate mixture at the rate of 1/4 kg/head/day. Fresh drinking water was daily available after grazing. Animals were permenantly kept in unshaded fence.

Measurements

Under solar radiation, certain physiological parameters that related to heat tolerance were recorded (twice at 08.00 and 14.00 hr) over 3 days before and 3 days after shearing of ewes during June 1989. Rectal temperature, °C, (RT) was measured using a clinical thermometer inserted in the rectum for 1 minute. Skin temperature, °C (ST) and coat temperature, °C (CT) were measured on the mid-side position using an electric telethermometer applied for 1 minute. Respiration rate (RR) was obtained by counting flank movement for 1 minute. At the same measuring times, ambient temperature °C (AT) using black-body instrument and relative humidity, % (RH)

using hair hygrometer were recorded. Immediately after shearing greasy fleece weight was recorded. A representative wool sample from each fleece was also taken to measure some wool traits. Staple length in cm and fibre diameter in um were measured using a ruler for the former and lanameter for the latter.

Statistical analysis

Data of physiological parameters were analysed using splitplot design (Kirk, 1968) since they were recorded twice per day on the same animals. However, in order to avoid repeated measurements for shearing treatment, the pre-shearing parameters of one half of 29 ewes taken at random to be tested versus the post-shearing parameters of the rest of experimental ewes. Also, simple correlation coefficients between wool traits and gain in physiological parameters due to heat exposure, were calculated and significantly tested.

Results and Discussion

Tolerance to heat stress under direct sun

Average radiant AT was observed to rise from 35°C at 08.00 hr to 49°C at 14.00 hr. Irrespective of ewe body cover, 6-hour exposure to direct sun resulted in significant ($P < 0.01$) increases in RT, ST and CT, i.e., 0.65, 1.85 and 3.67°C, respectively. The corresponding rise in RR was 15 breaths/min. (Table 1). These values, although significant, indicate that the heat-stressed Saidi ewes effectively maintained their homeothermy against the acute increase in AT. At a lesser thermal stress (40°C at midday), the fat-tailed Barki sheep used to show variations in RT and RR similar to those obtained in this study (Kawashti and Ghanem, 1965, Younis *et al,* 1977, Azamel *et al,* 1987). The marked contrast in thermal conditions between the two cases reflects the superiority of Saidi sheep in adaptability to heat than other local breeds. The heat stressed sheep, in general, have to manifold their RR in order to keep body temperature within a narrow range. Under tolerable heat stress, the limited shift of 1°C in RT indicates that the evaporative cooling is sufficient to regulate the body temperature (Salem *et al,* 1982). In this study, evaporative heat loss was likely the main available route for body cooling since the other sensible means were useless or even reversible as AT was higher than body temperature (Schmidt-Nielsen, 1984). The animal, in this case, was faced with heavy duty *i.e.,* dissipation of its own metabolic heat and also withstanding the external heat income from the environment. Saidi ewes might efficiently acheived this task as indicated by the limited increase in RT.

TABLE 1. Effect of shearing and time of day on rectal temperature, RT (°C); skin temperature, ST (°C); coat temperature, CT (°C) and respiration rate, RR (breaths/min).

Item	Unshorn			Shorn		
	08.00 hr	14.00 hr	Change	08.00 hr	14.00 hr	Change
RT (°C)	39.38	39.94	± 0.56	39.59	40.33	± 0.74
(Mean ± S.E.)	(39.66 ± 0.06)			(39.96 ± 0.06)		
ST (°C)	38.0	39.8	± 1.8	37.7	39.6	± 1.9
(Mean ± S.E.)	(38.89 ± 0.12)			(38.68 ± 0.12)		
CT (°C)	36.2	39.9	± 3.7	------	--------	------
(Mean ± S.E.)	(38.1 ± 0.30)					
RR (breaths / min)	34.4	49.3	+ 14.9	32.1	47.1	± 15.0
(Mean ± S.E.)	(41.9 ± 0.89)			(39.6 ± 0.89)		

* Mean ambient temperature at 08.00 and 14.00 hr was 35.0 ± 2.8 °C and 49.0 ± 3.6 °C, respectively. The respective values of relative humidity were 52.0 ± 2.0 % and 39.0 ± 1.5 %.

Average CT on the mid-side was rather low (39.9°C) inspite of the intensive heat load falling on Saidi ewes. For Australian Merino sheep standing in the sun, Macfarlane *et al,* (1958) reported 87°C for the tip wool on the back. The position on which CT is measured may partially be responsible for the difference between the two studies.

The relatively higher increase in CT (3.67°C) than those for ST (1.85°C) may indicate that the CT was more sensitive to the change in AT due to the direct contact of the coat to the environment.

Shearing and heat tolerance

The role of wool coat in thermoregulation is based either on its physical properties (Macfarlane, 1968) or on interacting with evaporative cooling function of skin surface (Blaxter *et al,* 1959). Wool fibres enclose a layer of still air reducting heat transfer from and to the body. Wool, therefore, acts as a buffering layer between skin surface and the environment (Macfarlane, 1968). On the average, closely shorn Saidi ewes had significantly ($P < 0.01$) higher RT and slightly lower RR and ST as com-

pared to unshorn ewes (Table 1). This result means that shearing impaired the heat tolerance of ewes as exposed to a severe heat stress. Moreover, the increase in RT was higher for shorn than for unshorn ewes (0.74 vs 0.56°C). Likewise, klemm (1969) found that unshorn sheep reacted to a lesser extent than shorn ones as exposed to heat. However, either RR or ST values changed similarly in shorn and unshorn ewes (Table 1). Shorn ewes might be deprived from the protective role of wool as insulator against the high AT. These animals also lost the privilege of some physical rejection for the solar radiation which may reach to the body core. On the other hand, the slightly low RR and ST of shorn ewes may suggest that shearing enhanced sweat evaporation through skin surface (Blaxter *et al,*1959 and Wodzicka 1960). Contrarily, shorn tropical Merino sheep respired twice in the sun than unshorn ones (Macfarlane *et al,* 1958 and klemm, 1969). The low heat tolerance of shorn ewes in this study might be attributed to the exposure to direct sun and lack of shade. Provision of shade to shorn sheep significantly improved their heat tolerance (reduced both RT and RR) as compared to unshorn ones (Eyal, 1963 and Younis *et al,* 1977).

Wool characteristics and heat tolerance

Certain wool traits and their correlation coefficients with the gain in each of physical parametrs were calculated (Table 2).

Staple length, fibre diameter and fleece weight were of the main features affecting the coat thermoregulation function. These traits respectively averaged 10.96 cm, 27.28 um and 1.337 kg, being lower values than those reported for Barki sheep, *i.e.,* 11.52 cm, 35.71 um and 2.490 kg (Guirgis, 1980). Previously, it was reported that the amounts of heat loss were inversely related to the hair length (Macfarlane, 1968; Parer, 1963 and khidr, 1990). The incidence of medullated fibre of the coares fleeces improved heat tolerance of animals (Dowling, 1959; Benjamin, 1985 and khidr, 1990). Although the relatively light fleeces of saidi sheep is rather less insulating one, it may represent an advantage as a more efficient in heat dissipation particularly during the cooler nights of desert. Fleece specification of saidi sheep forms certain adaptability to its environment. the dark-coloured wool though is a lesser rejector for the longwave sunlight but it acts against the penetration of ultraviolet into body core (Macfarlane, 1968).

Greasy fleece weight was correlated positively with the change in ST ($r = 0.53$) and negatively with the change in CT ($r = -0.49$) (Table 2). This indicates the im-

pact of fleece bulk on both skin and coat temperature. Heavy fleece though acts as better insulator barrier, it reduces the evaporative cooling via skin surface. Likewise, staple length and change in ST were significantly correlated (r = -0.50) indicating the increase of fleece insulating capacity as coat thickness increased. The relation between fibre diameter and the gain in ST was relatively low (r = -0.21) which may be due to the less coarse fibres of Saidi sheep. Thus, it could be concluded that the insulating function of Saidi sheep fleece depends mainly on both staple length and fleece bulk and little on fibre diameter.

Correlation between any of wool traits studied and change in either RT or RR was generally low and non-significant. This means that the increases in such two physiological parameters are primarily related to the intensity and duration of heat exposure and secondarily to the fleece nature. Accordingly, Seth *et al.* (1966) reported that the multiple correlations of RR and RT with environmental temperature and relative humidity were found to range from 0.33 to 0.83.

TABLE 2. Some wool traits (mean ± S.E.) and their correlation coefficients with the changes in each of physiological parameters as responses to heat exposure.

Item	Mean ± S.E.	Correlation with Gain in			
		RT	RR	ST	CT
Staple length (cm)	10.96 ± 0.31	0.02	0.02	- 0.49	-0.16
Fibre diameter (um)	27.78 ± 0.55	- 0.09	0.06	- 0.21	- 0.14
Greasy fleece weight (kg)	1.34 ± 0.06	0.08	0.04	0.53	- 0.49

It could be concluded that the wool coat of Saidi sheep plays an important role in thermal adaptability to the environment of upper Egypt. Shearing, therefore, should be practiced during early spring to give enough chance for wool growth in the hot months. Otherwise, natural or artificial shade must be provided to those sheep shorn in summer.

References

Azamel, A.A., Younis, A.A. and Mokhtar, M.M. (1987) The effect of shading, shearing and breed type on heat tolerance and performance of lambs under semi-arid conditions. *Indian Journal of Animal Sci.,* **57:** 1132.

Benjamin, B.R. (1985) The effect of cold on the medullation of the coat Jersy steers, Herford and Charolais cows. *Indian Vet. med. J.,* **9:** March 1985.

Blaxter, K.L., Graham, N. McC, Wainman, F.W. and Armstrong, D.G. (1959) Environmental temperature, energy metabolism and heat regulation in sheep. II. The partition of heat losses in closely clipped sheep. *J. Agric. sci.,* **52:** 25.

Dowling, D.F. (1959) The significance of the coat in heat tolerance of cattle. *Aust. J. Agric. Sci.,* **10:** 744.

Eyal, E. (1963) Shorn and unshorn Awassi sheep. I. Body temperature. III. respiration rate. IV. Skin temperature and humidity in the fleece and its surface. *J. Agric. Sci.,* **60:** 159.

Guirgis, R.A. (1980) Response to the use of Merino in improvement of some crossbreed wool traits. *J. Agric. sci.,* **95:** 339.

Kawashti, I.S. and Ghanem, Y.S. (1965) Comparative study of some physiological responses of two breeds of sheep to Egyptian coastal desert climate. I. Changes in body temperature, respiration rate and water consumption. *Bull. Fac. Sci., Cairo Univ.,* **40:** 143.

Khidr, R.E. (1990) Studies on the birthcoat of Friesian calves in relation to their future performance. *M. Sc. Thesis,* Faculty of Agric., Monofia Univ., Egypt.

Kirk, R.E. (1968) *Experimental Design Procedures for the Behavioural Science.* Brooks/Cole Publishers Company, Belmont, California, USA. pp. 245.

Klemm, G.H. (1969) The reactions of unshorn and shorn sheep to hot wet and hot dry atmospheres. *Aust. J. Agric. Res.,* **13:** 472.

Macfarlane, W.V. (1968) Adaptation of ruminants to tropics and deserts. In *Adaptation of Domestic Animals.* Ed. by E.S.E. Hafez. Lea and Febiger, Philadelphia, USA. pp. 164.

Macfarlane, W.V., Morris, R.J. and Howard B. (1958) Heat and water in tropical Merino sheep. *Aust. J. Agric. res.*, **9:** 217.

Parer, J.T. (1963) Wool length and radiant heating effect in sheep. *J. Agric. sci.*, **60:** 141.

Salem, M.H.,. Yousef, M.K , El-Sherbiny, A.A. and. Khalil, M.H (1982) Physiology of sheep and goats in the tropics. In *Animal Production in the Tropics.* E.d. by M.K. Yousef. Praeger Publishers, New York, USA. pp. 148.

Schmidt-Nielsen, K. (1984) *Desert Animals, Physiological Problems of Heat and Water.* Dover Pub., Inc. New York, USA.

Seth, O.N.; Saraswat, K.C. and. Roy, A (1966) Respiration and rectal temperature as measures of adaptability of different breeds and crossess of lambs and kids to tropical environment. *Agric. Univ. J. Res. Sci.*, 15: 17. (A.B.A., **36:** No. 2608).

Terrill, C.E. (1968) Adaptation of sheep and goats. In *Adaptation of Domestic Animals.* Ed. by E.S.E. Hafez. Lea and Febiger, Philadelphia, U.S.A. pp. 246.

Wodzicka, M. (1960) Seasonal varation in wool growth and heat tolerance of sheep. II. Heat tolerance. *Aust. J. Agric. Res.*, **11:** 85.

Younis, A.A., Al-Mahmoud, F., El-Tawil, E.A. and El-Shobokshy, A.S. (1977) Performance and heat tolerance of Awassi sheep as affected by early shearing. *J. Agric. Sci., Camb*, **89:** 565.

التحمل الحرارى فى الأغنام الصعيدى وعلاقته بالجز وبعض صفات الصوف

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استخدم فى هذا البحث ٥٨ نعجة صعيدي بالغة جافة ذات أعمار مختلفة بغرض دراسة تاثير جز الصوف على التحمل الحرارى للأغنام الصعيدى وعلاقة هذا التحمل ببعض صفات الصوف الطبيعية.

عندما تعرضت النعاج لأشعة الشمس لمدة ٦ ساعات يوميا (٨ صباحا - ٢ ظهراً) أرتفعت درجات حرارة كل من المستقيم وسطح الجلد وسطح غطاء الجسم بمقادير ٠,٦٥ ، ١,٨٥ ، ٣,٦٧ م على التوالى ، كما أرتفع معدل التنفس بمقدار ١٥ مرة فى الدقيقة. وكانت النعاج غير المجزوزة أكثر تحملا للحرارة من تلك المجزوزة حيث سجلت درجة حرارة المستقيم ٣٩,٦٦ ، ٣٩,٩٦ م فيهما على التوالى بفارق معنوى جداً بين المجموعتين وذلك على الرغم من أن معدل التنفس ودرجة حرارة سطح الجلد كانت أعلى قليلاً فى المجموعة غير المجزوزة عنها فى المجزوزة.

كان معامل الارتباط معنويا بين وزن الجزء الخام وكل من مقدار الارتفاع فى درجة حرارة سطح الجلد (ر = ٠,٥٣) والارتفاع فى درجة حرارة غطاء الجسم (ر = ٠,٤٩) بالمثل كان الارتباط بين طول الخصلة والتغيير فى درجة حرارة الجلد معنويا (ر = -٠,٥٠) ، بينما الارتباط بين قطر الليفة مع التغيير فى كل القياسات الفسيولوجية التى درست كان غير معنوى - كذلك كانت العلاقة ضعيفة بين التغيير فى درجة حرارة المستقيم أو فى معدل التنفس وكل صفات الصوف التى درست.

نوقشت النتائج من حيث أهمية غطاء الصوف والميعاد المناسب لجز الأغنام الصعيدى تحت ظروف أقصى جنوب مصر.