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Performance and physiological reactions of pure Awassi and East-Friesian x Awassi crossbred ewes in the sub-tropic Çukurova region

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SUMMARY - This study has been conducted with the objectives of determining the physiological responses and performance of pure Awassi and East-Friesian x Awassi crossbred ewes (F_1, F_2 and B1Aw = Backcross to Awassi) under Çukurova subtropical climatic conditions. Some of their physiological parameters such as rectal temperature, respiration and pulse rate have been taken at 7.00-8.00 a.m., at midday 11.00-12.00 and at 14.00-15.00 p.m. during the course of the experiment. In addition to this, their production performance such as litter size, lactation milk yield and lactation length have been determined. According to the results obtained, it is evident that the Awassi breed is superior to the crossbred genotypes in adaptability to the region's conditions. On the other hand, it can be said that B1Aw genotype has shown higher adaptability and in relation to this, they have shown higher performance than the other ewe groups.

Key words: Adaptation ability, sheep, Awassi, Ost-Friz x Awassi crossbred type, Çukurova subtropic condition.

RESUME - *"Performances et réactions physiologiques des brebis de race pure Awassi et des brebis croisées Frisonne de l'Est x Awassi dans la région subtropicale de Çukurova". Cette étude a été menée en vue de déterminer les réponses physiologiques et les performances des brebis de race pure Awassi et des brebis croisées Frisonne de l'Est x Awassi (F1, F2 et B1Aw = croisement en retour avec Awassi) dans les conditions climatiques subtropicales de Çukurova. Certains de leurs paramètres physiologiques tels que la température rectale, la respiration et le rythme des pulsations ont été enregistrés le matin à 7.00-8.00 h., à midi à 11.00-12.00 h., et à 14.00-15.00 h. pendant cette expérience. En plus, leurs performances de production telles que la taille de la portée, le rendement en lait pendant la lactation et la durée de la lactation ont été déterminées. D'après les résultats obtenus, il est évident que la race Awassi est supérieure aux génotypes croisés en ce qui concerne l'adaptabilité aux conditions de la région. Par ailleurs, on peut dire que le génotype B1Aw a montré une plus forte adaptabilité et comme conséquence, de meilleures performances que les autres groupes de brebis.*

Mots-clés : *Aptitudes adaptatives, ovins, Awassi, type croisé Frisonne de l'Est x Awassi, conditions subtropicales de Çukurova.*

Introduction

For the most part, assessments of suitability to hot environments have either been measures of "physiological adaptability" which may characterise animal tolerances as determined principally by shifts in heat balance or "performance adaptability" which describes changes in animal performance. In determining an animal's adaptability to hot environment through changes in physiological processes, a high correlation is assumed to exist between minimum shifts in heat balance in the animal's body and performance. By and large, the correlation's or regression coefficients between growth rate, reproduction of milk yield and changes in body temperature or respiration rate have been disappointingly low and often negative irrespective of species (McDowell and Woodward, 1982).

Heat stress seems to be one of the more intriguing factors making difficult animal production of many world areas. In fact the animals can adapt to the hot climate, nevertheless the response mechanisms are helpful for survival but are detrimental to performance (Webster, 1976). Animal

adaptation in a naive and dictionary sense means the fitness or suitability of animals to the conditions under which they live. But it is also a complex of evolutionary and genetic processes linked with physiological, immunological, biochemical and behavioural changes. All organs, tissues and cells can adapt to some extent (Macfarlane, 1982).

Domestic sheep are raised successfully under a variety of climatic and geographic conditions throughout the world. Diverse morphological and physiological characteristics of the many sheep breeds permit successful introduction of suitable breeds to any area, or provide an adequate gene pool for crossbreeding to produce suitable animals. It is important, to determine tolerance and adaptability of variety of breeds to different environmental stresses. Tolerances of exotic sheep breeds to hot environments have been compared with native, heat resistant breeds and their crossbred offspring, but most studies were concerned with short-term responses and seasonal differences (Monty *et al.*, 1991).

The small ruminants depend more on respiratory cooling. Evaporation from the respiratory tract can be an efficient means of promoting heat loss and is more appropriate for small animals than sweating because of a rapid rate of body heat storage and cooling. There is no evidence at this stage that lability of thermal stress can be measured as rise in body temperature, respiration rate or pulse rate of small ruminant to hot climates (McDowell and Woodward, 1982).

This study is conducted with the objectives of determining the physiological responses (such as rectal temperature, respiration rate, pulse rate) and performance (such as litter size, lactation milk yield, lactation length) of pure Awassi and East-Friesian x Awassi crossbred ewes under Çukurova subtropical climatic conditions.

Material and methods

This study was carried out at the Sheep Unit of Research Farm in Adana. 20 adult pure Awassi that is the native breed of the region and F_1 (1/2 Awassi, 1/2 East-Friesian), F_2 (F_1 x F_1) and B1aw (3/4 Awassi, 1/4 East-Friesian) crossbred ewes were used in this study. The data are collected from the beginning of June to the end of August. The ambient temperature and humidity are higher in this period than other times in Çukurova subtropic conditions. The mean temperature was 31.7 °C and humidity was 67.9% during the trial. The flock was housed semi-open shed under semi intensive conditions. They were offered alfalfa hay (*ad-libitum*), water and concentrates containing 12% crude protein and 2300 kcal/kg ME (*ad-libitum*). Also they grazed in this period.

Some of their physiological parameters such as rectal temperature, respiration and pulse rate are taken in the morning at 7.00-8.00 am, in midday at 11.00-12.00 and in afternoon at 14.00-15.00 p.m. during the course of experiment. The rectal temperature was taken with a calibrated rectal thermometer. Each reading was made at a constant depth of 5 cm and the insertion time was about three minutes. Respiration rates were measured 0.5 minutes by counting thoracic and flank movements to detect clearly. Also pulse rates were ascertained, by use of a stethoscope, through the ventral wall of the chest and also insertion time was 0.5 minutes.

In addition to this their production performance as litter size (such as birth type, birth weights and weaning weight of lambs), lactation milk yield and lactation length are determined. The milk recording is made twice a day, at 6.00-8.00 a.m. in the morning and 15.00-17.00 p.m. in the afternoon during the lactation period. The lactation milk yields and lactation lengths of ewes were calculated using Holland method (Kaymakçý and Sönmez, 1992).

The statistical analysis done by using Harvey computer programme and Duncan Method.

Results and discussion

Average rectal temperature, respiration rate and pulse rate of Awassi and its crossbred types were given in Table 1. According to the statistical analyses, physiological adaptation parameters of the native Awassi breed were significantly different from the others during the course of the experiment ($P<0.05$). Rectal temperature, pulse and respiration rate of this breed were lower than crossbred

types. The rectal temperature and respiration rate of F_1 and B1Aw were nearly same, F_2 was the highest, pulse rate of F_1 and F_2 were lower than B1aw.

Table 1. Rectal temperatures, respiration and pulse rate of pure Awassi and its crossbred types during the course of experiment

Traits	Awassi	F_1	F_2	B1aw	f
Rectal temperature (°C)	38.8 ± 0.19 b	39.1 ± 0.32 a	39.3 ± 0.28 a	39.1 ± 0.35 a	*
Respiration rate (breath/per minute)	55.2 ± 23.0 b	57.6 ± 23.0 ab	61.0 ± 13.0 a	58.9 ± 20.0 ab	*
Pulse rate (beat/per minute)	56.5 ±11.0 b	63.5 ± 15.3 ab	69.5 ± 10.2 ab	72.7 ± 13.0 a	*

*P<0.05
a, b: Values marked with different letters are significantly different

Rectal temperature of all the groups rose during the day. Average rectal temperature, respiration and pulse rate of groups in a day were given in Table 2. Average morning, midday and afternoon rectal temperatures, respiration and pulse rate of the four groups were significantly different (P<0.05) during the course of experiment. The average rectal temperature of Awassi significantly lower (P<0.05). Drastic rising of the rectal temperatures in the midday was observed in all groups due to increasing ambient temperatures. In afternoon average rectal temperatures were decreasing in all groups.

Table 2. The differences of rectal temperatures (RT, °C), respiration (RR, breath/min) and pulse rate (PR, beat/min) of pure Awassi and its crossbred types in a day

Traits	Hours	Awassi	F_1	F_2	B1Aw	f
RT	7-8 a.m.	37.2 ± 0.2a	38.0 ± 0.2b	38.7 ± 0.1b	37.9 ± 0.2a	*
	10-11 a.m.	38.5 ± 0.1a	39.9 ± 0.3b	39.9 ± 0.2b	38.8 ± 0.3a	*
	14-15 p.m.	37.5 ± 0.1a	39.3 ± 0.2b	39.5 ± 0.2b	38.0 ± 0.1a	*
RR	7-8 a.m.	45.0 ± 15.0a	57.2 ± 18.0b	61.0 ± 12.3b	56.2 ± 10.0b	*
	10-11 a.m.	58.6 ± 20.0a	76.0 ± 25.0b	79.2 ± 18.6b	62.5 ± 13.8ab	*
	14-15 p.m.	60.2 ± 12.0a	78.2 ± 12.3b	81.5 ± 12.8b	65.9 ± 19.5a	*
PR	7-8 a.m.	49.2 ± 15.6a	58.5 ± 23.5b	60.2 ± 10.2b	64.0 ± 13.0b	*
	10-11 a.m.	53.6 ± 12.3a	65.5 ± 23.0b	69.8 ± 20.5b	75.0 ± 23.1b	*
	14-15 p.m.	56.2 ± 15.3a	70.5 ± 17.0b	75.6 ± 19.5b	78.5 ± 12.9b	*

*P<0.05
a, b: Values marked with different letters are significantly different

The respiration rates rose during the day. The average respiration rate of Awassi has been lower than other groups, F_2 ewes have been the highest. The average respiration rates, of the ewes, rose with the increased ambient temperature. This rising was 15.2 breath/min, 21 breath/min, 20.5 breath/min, 9.7 breath/min in Awassi, F_1, F_2, B1aw, respectively. Although the Awassi had lower respiration rate , B1aw shown better performance in a day.

Average pulse rate was also rose during the day. The pulse rate of groups were significantly different (P<0.05). The pattern and magnitude of morning pulse rate of four groups different to those

of afternoon rates. Pulse rate of Awassi was consistently lower and pulse rate of B1aw was consistently higher than the other 2 groups during the course of experiment. Also the average pulse rates rose with the decreased ambient temperature and this decreased were not sharply in the afternoon. Differences between morning and afternoon pulse rate were 7 beat/min in Awassi, 12 beat/min in F_1, 15.4 beat/min in F_2 and 14.5 beat/min in B1aw.

The lactation milk yield, lactation length of the groups were given in Table 3. As seen in the table, lactation length and milk yield of groups were significantly different ($P<0.05$). There was significant difference between milk performances of the groups. The total milk yield of F_1 was the highest and pure Awassi was the lowest. But lactation length was longest in of B1aw and shortest in F_2.

Table 3. Lactation milk yield and lactation length of pure Awassi and its crossbred types in the lactation of the same year

Traits	Awassi	F_1	F_2	B1aw	f
Lactation length (day)	163.3 ± 23.0 ab	152.3 ± 22.0 b	137.6 ± 16.0 c	174.3 ± 30.0 a	*
Lactation milk yield (kg)	134.0 ± 24.9 b	157.0 ± 5.10 a	136.0 ± 2.08 b	148.0 ± 28.1 ab	*

*P<0.05
a, b: Values marked with different letters are significantly different

Birth types (twin or single), birth weight and weaning weights of lambs were given in Table 4. The twining rate was 1:2 in B1aw the other groups were same. There was no significant difference of birth weight of lambs ($P>0.05$), they were similar. But weaning weights were different. Growth performances of the lambs in B1aw group were better than the others. The lambs of F_1 were gained less weight than other 3 groups.

Table 4. Litter size of pure Awassi and its crossbred types in the lambing season of the same year

Traits	Awassi	F1	F2	B1aw	f
Birth type	1:1	1:1	1:1	1:2	-
Birth weight of lambs (kg)	4.93 ± 0.66	4.96 ± 0.25	4.60 ± 0.30	4.60 ± 0.40	-
Weaning weight of lambs (kg)	20.8 ± 3.07 ab	17.2 ± 1.65 b	21.2 ± 4.10 ab	24.0 ± 3.05 a	*

*P<0.05
a, b: Values marked with different letters are significantly different

Discussion

The physiological functions of an animal, such as rectal temperature, respiration and pulse rate, can favour its survival in a hot climate. Onset and degree of thermal stress in an animal is best reflected by a rise in rectal temperature and rely heavily on respiratory evaporative cooling mechanisms, by rapid and shallow respiration. Respiratory rates of sheep, exposed to high ambient temperatures become very rapid. Pulse rate of animals roughly parallels their metabolic rate.

In this study, different ewe groups were exposed to an entire season of intense heat. Results from experiment indicated that the increasing of rectal temperature associated with ambient temperatures during the heat exposures in the day. Eyal (1963a) demonstrated conclusively that the rectal temperatures of the ewes are 39.4 °C when the ambient temperature is higher than 30 °C. In this study the highest rectal temperature was 39.9 °C in the mid-day. And in the afternoon all groups decreased rectal temperatures. In this trial the highest rectal temperature was 39.5 °C. This was not higher than Eyal's results.

There appeared to be a trend toward depressed pulse rates when ambient temperature rose. Generally the pulse rate of ewes was increasing sharply during the day. In our experiment the highest pulse rate was 78.5 beat/min in B1aw. Eyal (1963c) indicated that the pulse rate of ewes rise until 3.00 p.m. and it start to decrease from this time. And the pulse rate of animals were indicated 70-85 beat/min, 97 beat/min, by Eyal (1963b) and McDowell and Woodward (1982), respectively. In this case our findings are lower than the above mentioned data.

Respiratory rate rose rapidly with increasing environmental temperature. The respiratory rate of ewes were found that 110 breath/min and 100 breath/min by Hopkins *et al.* (1979) and Eyal (1963c), respectively. In the experiment the highest respiration rate was 81.5 breath/min in F_2. Also this is lower than Hopkins *et al.* (1979) and Eyal's findings.

When examining the litter size, it is seen that B1Aw were superior to other genotypes, although birth weight of lambs were low. However they cough the others by the weaning time and the weaning weight of B1aw lambs were higher than the other genotype groups. The performances of the ewes were quite different. Lactation milk yields and lactation length of F_1 and B1aw were better than other two groups. It means although higher physiological functions, these ewes maintained their production. And they were well-adapted to the subtropic Çukurova conditions.

According to the results obtained, it is evident that Awassi breed is superior to the crossbred types in adaptability to the region conditions. On the other hand, it can be said that B1aw type has shown higher adaptability and in relation to this, they had higher performance than the other ewe groups.

Clearly there is no simple means for determining animal adaptation and our knowledge is limited. In spite of these restrictions, our state of inquiry has reached a stage where a certain rationale can be made about the relative importance of various traits to animal adaptation and we can draw at least general conclusions on differences among species which can be useful. Probably our most serious limitation at this time is awareness of the value of modifications or manipulations of the environment which may be practical for enhancing animal performance. On the other hand from now on primary objective of our research will be focused in typing physiological adaptation mechanisms of small ruminants as blood characteristics and polymorphic parameters.

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