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Araştırma Makalesi

A Study on Comparison of Some Physiological Adaptation Parameters of Different Goat Genotypes under the Eastern Mediterranean Climatical Condition

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Abstract

This study was carried out to test some exotic goat breeds (Saanen goat and German fawn x Hair goat crossbred) whether they adapt to the Eastern Mediterranean region of Turkey by measuring rectal temperature, respiration number and pulsation number. This study was begun on the 1st June and ended on the 30th November, 2003. All animals were pastured and fed (500 g per day) with a diet having 16% crude protein and 2647 Kcal ME kg^{-1} prepared from barley, cotton seed meal, wheat bran, alfalfa straw, salt and vitamin-mineral mixture. Pulsation number was determined by stethoscope from the jointing point of left-front leg and body, respiration number from ribs. Rectal temperature was measured by using digital thermometer. These parameters were recorded at 08:00, 11:00, 14:00, 17:00, 20:00 and 23:00 on Monday of each week during the study. At the end of study, it was detected that rectal temperature was very similar but respiration and pulsation numbers were different among the genotypes. Season and hour of day, also, affect the parameters. To conclude, the physiological parameters showed that the exotic breeds may adapt to the climate conditions of East Mediterranean region of Turkey.

Key words: Goat, respiration number, pulsation number, rectal temperature

Doğu Akdeniz Bölgesi İklim Şartlarında Farklı Keçi Genotiplerinin Bazı Fizyolojik Adaptasyon Parametrelerinin Karşılaştırılması Üzerine Bir Araştırma

Özet

Bu çalışma bazı egzotik keçi ırklarının (Saanen keçisi ve Alman Alaca keçisi x Kıl keçi melezleri), rektal sıcaklık, solunum sayısı ve nabız sayının tespiti yolu ile Türkiye'nin Doğu Akdeniz bölgesine adapte olup olmadığını araştırmak için yapılmıştır. Çalışma 1 Haziran 2003 tarihinde başlamış ve 30 Kasım 2003 tarihinde sona ermiştir. Çalışmada tüm hayvanlara meraya ilave olarak arpa, pamuk tohumu küspesi, kepek, yonca samanı, tuz ve vitamin-mineral karışımından oluşan kesif yemden (%16 ham protein ve 2647 kcal ME kg-1) hayvan başına 500 g/gün verilmiştir. Nabız sayısı stethoscope yardımı ile sol ön bacağın vücuda birleşme noktasından, solunum sayısı ise kaburgalar üzerinden alınmıştır. Rektal sıcaklık dijital termometre ile ölçülmüştür. Bu parametreler her hafta pazartesi günü saat 08:00, 11:00, 14:00, 17:00, 20:00 ve 23:00'da ölçülmüştür. Çalışma sonunda, genotipler arasında rektal sıcaklık bakımından önemli bir farklılık olmadığı, buna karşın nabız ve solunum sayılarının farklılık arz ettiği saptanmıştır. Mevsim ve günün saatleri de parametreler üzerine etkili olmuştur. Sonuç olarak, çalışma materyali keçi genotiplerinin üzerinde çalışılan fizyolojik parametreler bakımından Doğu Akdeniz bölgesi iklim koşullarına adapte olabileceği söylenebilir.

Anahtar kelimeler: Keçi, solunum sayısı, nabız sayısı, rektal sıcaklık

Introduction

During the last 20 years, the number of goats around the world has increased by about 58%, while the increases of cattle and sheep stocks were 10% and 22% only, respectively. Now, the world goat population is the third largest after cattle and sheep and before pigs. Goat numbers in total main ruminant species moved from 16% in 1980 to 23% in 2000. The progress of goat stocks was very regular, and that this increase involved particularly the countries with low income at 70 %, but also countries high and intermediate income; 20% and 25%, respectively (Morand-fehr *et al.,* 2004). The developing countries are generally located in tropical and sub-tropical climate conditions. Mediterranean region of Turkey, which has got intermediate income, has sub-tropical climate condition. Goat production is very important for people living on sub-tropical mountainous regions of Turkey. Even though there are 7 201 000 head of goats, income of goat sector in Turkey is not sufficient. This is due to raising native Hair goat breed which has low milk yield and litter size (Yalçın, 1986; Kaymakçı and Aşkın, 1997) in highest proportion (94.8%) in the country (SSI, 2000; FAO, 2004; Yalçın,

1986). In order to Hair goat, Kilis and Shami (Damascus) goats, known with high milk yield, are also found in the south-east part of Turkey (Güney *et al.,* 1992; Keskin and Biçer, 2002; Keskin *et al.,* 2004).

For improving of goat population, lots of project has been performed on the country and Hair goat were crossbred with some exotic breeds in different study (Güney *et al.,* 1992; Kaymakçı and Aşkın, 1997). However, there have been insufficient studies about adaptation capabilities of these breeds. It is expected that performances of the breeds (Saanen, Alpine and Shami) could be different under the climatical and ecological conditions of the eastern Mediterranean region when they are compared with their original raising regions. When an animal is brought to foreign region, it reacts to unfavourable environmental conditions by increasing the heat loss through processes of evaporation which is mainly represented by sweating and increasing respiration rate (Cappa *et al.,* 1991). Temperature plays a major role among the various environmental factors affecting productive characters in small ruminants. In addition to that, difficulties in adaptation of farm animals is not only attributed to temperature problems but also, feeding, grazing conditions, diseases, and breeding season for sheep and goat species have effects (Flamant, 1991).

The purpose of this study is to compare rectal temperature, respiration number and pulsation number of pure culture breed (Saanen goat), crossbred genotype (German Fawn x Hair goat B_1 crossbred) with the local breed (Damascus, known as Shami goat by Arabic originated people of region) under the East Mediterranean condition of Turkey during the six months.

Material and Methods

This study was carried out at the Research and Training Farm of Mustafa Kemal University in Antakya province of Turkey. Antakya is located between 36º north latitude and 36º east longitude in the eastern Mediterranean region. German fawn x Hair goat B_1 crossbred (n= 8), Saanen (n= 4) and Shami (n=10) goats were consist of as animal material of the study. The coat colour of genotypes were white for Saanen goat, brown unicoloured with black back stripe and light or dark belly for the crossbred goats, and brown for Shami goat. After three months from beginning of the study, Saanen goats were had to be sold. For this reason, the study was continued with the other genotypes. Experimental goats in all group were one yearling and raised under similar conditions in the same farm.

The study was continued 6 months; it began on the 1st June and ended on the 30th November, 2003. All experiment animals were pastured and additionally fed a diet, including 16% crude protein and 2647 Kcal ME kg^{-1}, prepared from barley, cotton seed meal, wheat bran, alfalfa straw, salt and vitamin-mineral mixture. The diet was given to animals 500 g per day.

Pulsation number, respiration number and rectal temperature of animals were determined with following methods. Pulsation was measured by a stethoscope from the jointing point of left-front leg and body, respiration was from ribs. These parameters were expressed number of parameter per minute. Rectal temperature was measured by a digital thermometer. For this measurement, digital thermometer was inserted 5 cm to rectum and waited for 3 minutes. These parameters were recorded at 08.00, 11.00, 14.00, 17.00, 20.00 and 23.00 on Monday of each week during the study. Environmental temperature and humidity values were, also determined at the same hours of the days. Data were analysed using the "one-way" ANOVA procedure and means were compared with Duncan multiple range test (SPSS, 2001). The mathematical model of experiment is as following;

$Y_{ij}= \mu+g_i+e_{ij}$

where Y_{ij}, dependent variables (respiration number, pulsation number and rectal temperature)
μ, general mean common to all observation
g_i, the effect of i^{th} genotype
$e_{ij,}$ residual effect peculiar to each observation

Results and Discussion

The physiological parameters of experimental goats are given in Table 1.

Table 1. Respiration number, pulsation number and rectal temperature (mean±s.e.) of the genotypes used in the study during the six months

Genotype	Respiration number	Pulsation number	Rectal temperature
Cr	41.3 ± 0.54^b	88.1 ± 0.43^c	38.9±0.01
Sa	37.4 ± 1.14^a	82.3 ± 0.83^a	39.0±0.03
Sh	44.1 ± 0.50^c	84.7 ± 0.37^b	39.0±0.01
Sig	***	***	NS

Cr, German fawn x Hair goat (B_1) crossbred; Sa, Saanen goat; Sh, Shami goat; Sig, significance; ***, P<0.001; NS, non-significant; different letters as superscript in same column shown significantly differences among the genotypes.

Table 2. Respiration number, pulsation number and rectal temperature (mean±s.e.) of experimental goats during the day

	Hours						
	08.00	11.00	14.00	17.00	20.00	23.00	Sig
Gen	Respiration number						
Cr	33.0±1.03^{a}	44.3±1.33^{c}	52.4±1.52^{e,AB}	47.7±1.40^{d}	37.6±1.05^{b,AB}	32.5±0.87^{a,B}	***
Sa	33.0±2.50^{a}	41.2±2.94^{bc}	47.4±3.50^{c,A}	41.1±2.97^{bc}	33.7±1.94^{ab,A}	28.1±1.48^{a,A}	***
Sh	36.1±1.06^{a}	46.7±1.17^{c}	56.8±1.30^{e,B}	50.3±1.26^{d}	40.1±0.98^{b,B}	34.3±0.90^{a,B}	***
Sig	NS	NS	**	NS	*	*	
	Pulsation number						
Cr	85.3±1.02^{ab}	87.3±1.00^{bc,B}	90.3±1.14^{c,B}	94.3±1.11^{d,B}	87.9±0.94^{bc,B}	83.7±0.93^{a}	***
Sa	82.6±2.19^{a}	80.1±1.89^{a,A}	81.7±1.93^{a,A}	89.7±2.31^{b,A}	82.4±1.74^{a,A}	80.4±1.91^{a}	**
Sh	82.9±0.93^{ab}	84.1±0.97^{b,AB}	87.1±0.99^{c,B}	89.8±0.92^{d,A}	84.0±0.81^{b,A}	84.9±0.78^{a}	***
Sig	NS	**	**	**	**	NS	
	Rectal Temperature						
Cr	38.5±0.03^{a}	38.9±0.02^{c}	39.1±0.02^{e}	39.3±0.02^{f}	38.8±0.03^{d}	38.9±0.01^{b,A}	***
Sa	38.7±0.07^{a}	39.0±0.05^{b}	39.1±0.06^{bc}	39.3±0.06^{c}	39.1±0.06^{b}	39.0±0.06^{b,B}	***
Sh	38.6±0.03^{a}	38.9±0.02^{c}	39.1±0.02^{d}	39.4±0.02^{e}	39.1±0.02^{d}	38.8±0.03^{b,A}	***
Sig	NS	NS	NS	NS	NS	*	
ET	25.2	31.3	34.6	31.5	27.0	23.6	
EH	70.7	68.6	66.3	67.9	71.4	74.5	

Gen, genotype;Cr, German fawn x Hair goat (B_1) crossbred; Sa, Saanen goat; Sh, Shami goat; Sig, significance; *, P<0.05; **, P<0.01; ***, P<0.001; NS, non-significant; capital letters as superscript in same column show significant differences among the genotypes; smalll letters as superscript in same line show significant differences among the hours for the same genotypes, ET, Environmental temperature (ºC); EH, Environmental humidity

Respiration number, pulsation number and rectal temperature are the parameters which illustrate the mechanism of physiological adaptation. Rectal temperature of the genotypes were very similar among each other (P>0.05). On the other hand, there were important differences due to the respiration number and pulsation number per minute among the genotypes (P<0.001). This kind of differences in same genotypes was also reported in different studies carried out at Eastern Mediterranean region of Turkey (Güney *et al.*, 1991; Güney and Koluman 1992). The means for these parameters were higher than that of thermo-neutral zone that is reported by McDowell and Woodward (1982) who informed that respiration rate was 25.3 per minute for goats in thermo-neutral zone (comfort zone; 13-15 ºC). This may be accepted by a usual result of higher environmental temperature and humidity.

The situations of these parameters during the day are given in Table 2. As seen in the table, all observed parameters changed depending on the environmental temperature and humidity during the day. In each observation hours, statistically important differences were observed among the genotypes. While respiration number increased until 14.00, increment in rectal temperature and pulsation number continued until 17.00, for all genotypes. According to the reports of Bianca and Kunz (1978), increasing of environmental temperature affects firstly pulsation number. Then, such high pulsation number increases the rectal temperature. Heat loss via high respiration number was higher than that via other ways (Devendra, 1987). Blight (1985) reported that a daily change of respiration number per minute by the effect of environmental temperature does not show parallelity with changing of body temperature and pulsation number. With removing of this effect, animals go back to the former respiration number. The present results about different respiration number depend on time is in line with the reports of different researchers (Quatermain and Broadbend, 1974; Bianca and Kunz, 1978; Ogebe *et al.*, 1996).

While rectal temperature of genotypes differed depending on the environmental temperature, no differences were found among the genotypes in each observation times except 23.00. Rectal temperature of goats in sub-tropical conditions were reported as 39.3-39.5 ºC in several studies which were carried out for determining the effect of high environmental temperature on rectal temperature (Joshi *et al.*, 1977; Bianca and Kunz, 1978; Devendra, 1987). Our finding was also in line with these reports.

Pulsation and respiration number per minute was clearly increased by the effect of environmental temperature. Devendra (1987) informed that changes of metabolism and muscle activity of goats also cause changes in these numbers. On the other hand, Saanen goats which have short and white colour hair had generally lowest means of respiration number, pulsation number and rectal temperature in each observation time in comparison to

the other genotypes. No change was observed in metabolic speed of black haired goat and white haired goat when these animals were kept under the shade condition (D'miel *et al.,* 1980). On the other hand, when animals were exposed to directly sun ray metabolic speed and body temperatures of black haired goats increased depending on oxygen intake. Such changes were observed in black haired goats, which were exposed by absorption of high solar radiation level (D'miel *et al.,* 1980). Acharya *et al.* (1985) also informed that coat colour and hair length could affect these parameters. According to their report, short haired goats had higher respiratory and pulse rate than long haired goats. Hair colour has, also, an effect on changes of respiration number, pulsation number and rectal temperature during the day. They also found that increase of these parameters in afternoon was higher in black haired goats. They were followed by dark brown, light brown and white haired goats in decreasing order.

Monthly changes in respiration number, pulsation number and rectal temperature are given in Table 3. As seen in Table 3, the genotypes have different average respiration number except 5th month and have different pulsation number except 4th and 5th month. While the lowest respiration number was found in Saanen, the highest pulsation numbers were determined in crossbred goats. But rectal temperature of genotypes was not different among genotypes in all months. Our results are in agreement with Ogebe *et al.* (1996) who informed that season significantly effect pulsation number, rectal temperature and respiration number of goats.

As conclusion, the means of observed physiological adaptation parameters of Saanen and German fawn x Hair goat crossbreds (B_1) show that these genotypes may be recommended to the goat keepers in the eastern Mediterranean region of Turkey without any negative effect due to adaptation mechanisms. The colour and length of hair provide advantages to the animals for these genotypes, especially in Saanen goat.

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Table 3. Respiration number, pulsation number and rectal temperature (mean±s.e.) of experimental goats during the 6 months after 1st of June

Months	ET	EH	Genotypes			Sig
			Crossbreeds	Saanen	Shami	
Respiration number						
1	28.5	55.4	$42.6\pm1.45^{ab,A}$	$39.9\pm1.90^{a,B}$	$45.8\pm1.39^{b,C}$	*
2	29.5	63.8	$44.6\pm1.48^{ab,B}$	$42.4\pm2.15^{a,B}$	$49.3\pm1.47^{b,C}$	*
3	30.7	65.8	$33.5\pm0.93^{b,A}$	$27.6\pm1.00^{a,A}$	$31.1\pm0.54^{b,A}$	**
4	32.0	53.6	35.3 ± 1.39^{A}		40.4 ± 1.34^{B}	*
5	29.0	68.2	45.3 ± 1.33^{B}		48.2 ± 1.15^{C}	NS
6	28.5	70.5	44.9 ± 1.10^{B}		47.7 ± 0.88^{C}	*
Sig			***	***	***	
Pulsation number						
1	28.5	55.4	$93.3\pm1.06^{b,C}$	$89.4\pm1.36^{a,C}$	$89.0\pm1.07^{a,D}$	**
2	29.5	63.8	$88.3\pm0.86^{b,B}$	$85.4\pm1.10^{a,B}$	$85.2\pm0.84^{a,C}$	*
3	30.7	65.8	$76.4\pm0.83^{b,A}$	$70.8\pm1.02^{a,A}$	$72.1\pm0.58^{a,A}$	***
4	32.0	53.6	77.9 ± 1.02^{A}		75.3 ± 0.80^{B}	NS
5	29.0	68.2	92.9 ± 0.86^{C}		91.1 ± 0.76^{DE}	NS
6	28.5	70.5	97.0 ± 0.77^{D}		92.6 ± 0.62^{E}	***
Sig			***	***	***	
Rectal temperature						
1	28.5	55.4	39.1 ± 0.03^{B}	39.1 ± 0.04^{B}	39.1 ± 0.03^{C}	NS
2	29.5	63.8	39.1 ± 0.03^{B}	39.1 ± 0.04^{B}	39.1 ± 0.03^{C}	NS
3	30.7	65.8	38.9 ± 0.03^{A}	38.8 ± 0.04^{A}	38.9 ± 0.02^{AB}	NS
4	32.0	53.6	38.8 ± 0.03^{A}		38.9 ± 0.03^{AB}	NS
5	29.0	68.2	38.9 ± 0.03^{A}		39.0 ± 0.03^{B}	NS
6	28.5	70.5	38.9 ± 0.03^{A}		38.9 ± 0.02^{A}	NS
Sig			***	***	***	

Cr, German fawn x Hair goat (B_1) crossbred; Sa, Saanen goat; Sh, Shami goat; Sig, significance; *, P<0.05; **, P<0.01; ***, P<0.001; NS, non-significant; capital letters as superscript in same column show significant differences among months for each genotypes; small letters as superscript in same line show significant differences among genotypes for each months; ET, Environmental temperature (ºC); EH, Environmental humidity

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