

Impact of shearing on body weight and serum total proteins in ewes

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Abstract

The aim of the present study was to evaluate the influence of shearing ewes during summer season on the evolution of body weight and serum total proteins. Forty Valle del Belice (Sicily, Italy) ewes, clinically healthy and well-fed, were divided into two groups of 20 subjects each. Twenty ewes were let unshorn as a control group (Group A) and 20 ewes were shorn (Group B). All animals were weighed using a mechanical balance in the morning before shearing and the measurements were repeated for each subject of Groups A and B after shearing (1 day) and after 7, 15, 30, 45, 60, 75 and 90 days from the shearing. In experimental days climatic conditions were recorded and temperature humidity index was calculated. Blood samples were collected by means of a jugular venipuncture and were centrifuged; and the obtained sera were separated to assess serum concentration of total proteins. Two-way repeated measures analysis of variance (ANOVA), followed by the Bonferroni's test, was used to determine significant differences between two groups for body weight and total proteins. ANOVA did not show a significant effect of shearing and of time on body weight but showed a statistical significant effect of shearing and of time on total proteins. These confirm that shearing induces adaptive responses in the organism. Both shorn and unshorn ewes are subject to heat stress, but it is evident a different sensitivity to heat stress in shorn ewes in comparison with unshorn ewes.

Additional key words: blood parameters, environmental condition, fleece, sheep.

Resumen

Impacto del esquilado sobre el peso corporal de las ovejas y sus proteínas séricas totales

El objetivo del presente estudio fue evaluar la influencia del esquilado de ovejas durante la temporada de verano sobre la evolución del peso corporal y las proteínas séricas totales. Cuarenta ovejas del Valle del Belice (Sicilia, Italia), clínicamente sanas y bien alimentadas, se dividieron en dos grupos de 20 individuos cada uno. Veinte ovejas se dejaron sin esquilado como grupo control (Grupo A) y 20 ovejas fueron esquiladas (Grupo B). Todos los animales fueron pesados por la mañana antes de la corta utilizando una balanza mecánica y las medidas se repitieron para cada individuo de los Grupos A y B 1, 7, 15, 30, 45, 60, 75 y 90 días después del esquilado. Durante los días de experimentación se registraron las condiciones climáticas y se calculó el índice de temperatura-humedad. Se obtuvieron sueros en los que se evaluó la concentración de proteínas totales. Se utilizaron análisis ANOVA, seguidos del test de Bonferroni, para determinar diferencias significativas entre los dos grupos para el peso corporal y las proteínas totales. No hubo un efecto significativo del esquilado y del tiempo transcurrido sobre el peso corporal, pero sí hubo efecto significativo del esquilado sobre las proteínas totales. Esto confirman que el esquilado induce respuestas de adaptación en el organismo. Tanto las ovejas esquiladas como las que no se esquilaban estuvieron sometidas a estrés por calor, pero la sensibilidad de los dos grupos a este estrés es diferente.

Palabras clave adicionales: condiciones ambientales, lana, ovejas, parámetros sanguíneos.

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Abbreviations used: BCS (body condition score), THI (temperature humidity index).

Introduction

The maintenance of the homoeothermic condition in ewes is influenced by the characteristics of their fleece, which are correlated to age, breed, sex and to temperature, relative humidity and wind (Sleiman and Abi Saab, 1995). Studies of shorn and unshorn ewes, exposed to extreme environmental conditions, have long demonstrated the importance of the fleece for the maintenance of homoeothermic conditions (Mcfarlane, 1968; Whittow, 1971).

Ewes are most commonly shorn once a year; however, shearing takes place twice annually in some localities of the world (Dýrmundsson, 1991), so some researchers evaluated the effects of shearing at the end of summer and at the end of winter (Hetem *et al.*, 2009). The traditional shearing time is spring and early summer, in particular in southern Italy the production system of ewes involves shearing at the beginning of summer to coincide with favorable climatic conditions (Dýrmundsson, 1991). The removal of the fleece in animals adapted to grazing under the sun at the hottest times of day is considered a necessary practice by the shepherds, not only for hygienic reasons, but also to enable animals to better withstand exposure to high temperatures. In contrast with this traditional practice, it has been recognized that, for ewes, a mean of defense against external factors is its woolen coat that helps to create good thermal conditions to enable normal physiological, functional and hence, productive process (Avondo *et al.*, 2000). Previously, the important role of shelter's microclimate on the welfare of animals, with a subsequent optimization of productive performance, was showed (Piccione and Caola, 2003; Piccione *et al.*, 2003). The effect of shearing on physiological and haematochemical parameters was reported by several researchers (Symonds *et al.*, 1986, 1988; Dýrmundsson, 1991; Piccione *et al.*, 2008a,b), and some of them demonstrated the influence of shearing on heat stress. However, the literature provides only little information about effects of shearing ewes on lamb birth weights (Austin, 1977) and on level of hydration (Pennisi *et al.*, 2004). On this basis, the aim of the present study was to evaluate the influence of shearing during summer season on the evolution of body weight and serum total proteins in Valle del Belice (Sicily, Italy) ewes.

Material and methods

The study was carried out in a farm located in Valle del Belice, Sicily (38° 12' N; 13° 32' E) at an altitude

of 300 m.a.s.l. Environmental temperature was measured by means of a thermometer freely exposed to the air but shielded from radiation and moisture.

Temperature humidity index (THI) was calculated using the following equation:

$$THI_{[^{\circ}C]} = t_{bs} - (0.55 - 0.55 \phi/100) (t_{bs} - 14.4)$$

where t_{bs} = dry-bulb temperature ($^{\circ}C$) and ϕ = relative humidity (%).

The study was conducted on 40 pregnant, two-years-old, clinically healthy and well-fed, Valle del Belice ewes. As concerning feeding conditions, all animals were fed in the field daily on hay (2 kg), wheat straw (1 kg), wheat concentrate (0.5 kg) and water *ad libitum*.

The following experimental protocol was used: the animals were divided into two groups (Group A and Group B), each of twenty animals. The ewes in Group A were let unshorn, as a control group, while the ewes in Group B were shorn.

All animals were weighed using a mechanical balance in the morning before shearing and after shearing (1 day) and were repeated after 7, 15, 30, 45, 60, 75 and 90 days from the shearing date. In experimental days blood samples were collected by means of a jugular venipuncture. Samples were centrifuged at 3,000 rpm for 10 min; and sera were separated and stored at $-4^{\circ}C$ until analyses. In each individual sample, serum concentration of total proteins was analysed with a commercially available kit by means of a UV spectrophotometer (model Slim SEAC, Firenze, Italy). Body condition score (BCS, 0 to 5 scale; Russel *et al.*, 1969) was assessed before shearing and 45 and 75 days after shearing.

Statistical analysis was performed using the average values of the data obtained. Two-way repeated measures analysis of variance (ANOVA) was used to determine significant differences. It was used for assessment of effects due to shearing and time. *P* values < 0.05 were considered statistically significant. Bonferroni's test was applied for post-hoc comparison. Data were analyzed using STATISTICA 7.0 (Stat Soft Inc.) software package.

Results and discussion

Average mean, min and max value of the environmental temperature and relative humidity levels on the experimental days are presented in Table 1. Also THI values, calculated at the sampling (11.00 a.m.) of experimental days considered, are shown in Table 1.

Table 1. Average mean, minimum and maximum values of the environmental temperature and relative humidity levels during the experimental days. Temperature humidity index (THI) values, calculated at the sampling (11.00 a.m.) during the experiment

	Temperature (°C)			Relative humidity (%)			THI
	Mean	Min	Max	Mean	Min	Max	
Before shearing	25.7	21	29	65.9	54	78	25.65
After shearing	26.8	20	29	61.9	47	73	25.14
After 15 days	26.6	24	29	67.0	60	78	25.35
After 30 days	31.6	26	34	40.9	24	58	28.35
After 45 days	28.2	23	30	59.2	48	74	24.87
After 60 days	25.5	23	29	54.8	48	64	25.35
After 75 days	26.3	22	29	64.4	48	78	22.98
After 90 days	22.2	18	25	69.7	60	82	21.31

Table 2. Average values (\pm standard deviations) of body weight (kg) and total proteins (g L^{-1}), together with the relative statistical significances, in Group A (unshorn ewes) and Group B (shorn ewes) during the experiment

Variables	Group	Experimental period							
		Before shearing	After shearing	After 15 days	After 30 days	After 45 days	After 60 days	After 75 days	After 90 days
Body weight (kg)	A	47.60 \pm 4.05	47.60 \pm 4.05	47.74 \pm 3.59	47.76 \pm 3.24	47.62 \pm 3.29	48.44 \pm 3.55	47.58 \pm 3.53	47.61 \pm 3.07
	B	48.40 \pm 5.20	46.65 \pm 5.10	46.46 \pm 4.45	46.56 \pm 4.20	47.82 \pm 3.59	46.91 \pm 4.59	45.90 \pm 3.16	45.65 \pm 2.89
Total proteins (g/l)	A	76.30 \pm 4.80	76.30 \pm 4.80	73.30 \pm 5.00	76.40 \pm 5.90	71.90 \pm 5.40 ^{bce}	67.20 \pm 6.30 ^{bcddef}	73.10 \pm 3.70 ^e	72.40 \pm 3.90 ^{eg}
	B ^a	77.10 \pm 5.60	75.00 \pm 6.30	76.50 \pm 4.70	78.00 \pm 5.10	74.50 \pm 4.80	70.70 \pm 7.20 ^{bcdce}	72.40 \pm 5.00 ^{bde}	74.60 \pm 6.50

^a vs Group A, $P < 0.05$. ^b vs Day 0, $P < 0.05$. ^c vs Day 1, $P < 0.05$. ^d vs Day 15, $P < 0.05$. ^e vs Day 30, $P < 0.05$. ^f vs Day 45, $P < 0.05$. ^g vs Day 60, $P < 0.01$.

The average values of body weight and total proteins, together with standard deviation of the means (SD) and with the relative statistical significances, for Groups A and B, are presented in Table 2. Two-way ANOVA did not show a significant effect of shearing and time on body weight. Instead ANOVA showed a statistical significant effect of shearing on total proteins ($F_{(1,266)} = 1.55$, $p = 0.008$) and a significant effect of time on total proteins ($F_{(7,266)} = 17.32$, $p < 0.0001$). Figure 1 shows the pattern of mean value of total proteins and temperature in ewes of Groups A and B during the experiment.

Also two-way ANOVA was applied for BCS, showing that BCS did not change. Table 3 shows the average values and standard deviations (SD) of BCS in Group A (unshorn ewes) and in Group B (shorn ewes) before shearing, 45 and 75 days after shearing.

Our results suggest the influence of the fleece in ewes on serum concentration of total proteins. The shearing, in fact, has not a significant effect on body weight in ewes because the removal of the fleece, considered a necessary practice for hygienic conditions,

does not involve a significant difference in weight between the two groups, since the weight of the fleece is minimal (0.80 kg).

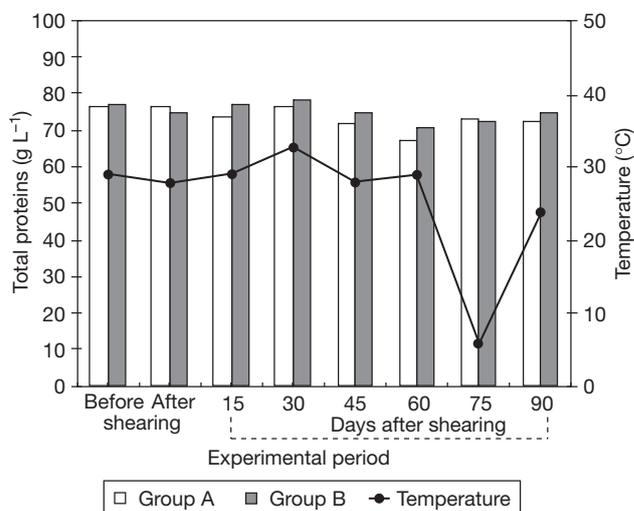


Figure 1. The pattern of environmental temperature and total proteins during experimental period in unshorn (Group A) and shorn (Group B) ewes.

Table 3. Average values and standard deviations (SD) of body condition score (BCS) in Group A (unshorn ewes) and in Group B (shorn ewes) before shearing, 45 and 75 days after shearing

Body condition score	Group A		Group B	
	Mean	SD	Mean	SD
Before shearing	2.62	0.1	2.61	0.09
After 45 days	2.66	0.1	2.65	0.07
After 75 days	2.61	0.09	2.56	0.12

On the contrary, the response of total proteins was of particular interest. The removal of the fleece, in fact, results in changes in the metabolism of proteins in relation to exposure to heat stress (Marai *et al.*, 2004, 2007). The changes in serum concentration of total proteins may be due to fluid shift between the compartments of the organism that assume an important role as far as the physical protection in comparisons of the temperature. The exposure of ewes to elevated ambient temperatures, the main environmental stressing factor that impose strain on animals (Finch, 1984; Silanikove 2000), induces an increase in the dissipation of excess body heat, in order to negate the excessive heat load (Marai *et al.*, 2007). As previously observed for haematocrit values, the total proteins concentration was lower in unshorn ewes in comparison to the shorn ewes, and these values indicate a higher level of hydration in these animals (Pennisi *et al.*, 2004). Therefore, it is possible to evidence a haemoconcentration characterized from an increase of total proteins in shorn ewes (Piccione *et al.*, 1994). Haematocrit value and total proteins concentration reflect changes in plasma volume that in this case did not involve significant haemodynamic consequences, although it is known that an increase in the haematocrit or total proteins corresponds to an increase in the viscosity of the blood producing an increase in arterial pressure (Hales *et al.*, 1973, 1984).

In conclusion these results confirm that shearing induces adaptive responses in the organism. Both shorn and unshorn ewes were subject to heat stress, but it is evident a larger sensitivity of shorn ewes to heat stress in comparison with unshorn ewes.

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