



Heat tolerance index, food intake and weight gain of Santa Inês sheep in the agreste region of Pernambuco State, Brazil

Florisval Protásio da Silva Filho^{1*}, Marcílio de Azevedo¹, Lígia Alexandrina Barros da Costa¹, Ângela Maria Quintão Lana², Marcelo de Andrade Ferreira¹ and Ângela Maria Vieira Batista¹

¹Universidade Federal Rural de Pernambuco, Av. Dom Manoel de Medeiros, s/n, 52171-900, Dois Irmãos, Recife, Pernambuco, Brazil.

²Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil. *Author for correspondence. E-mail: florisvalprotasio@yahoo.com.br

ABSTRACT. This study evaluated the influence of coat color on the heat tolerance and performance of 21 Santa Inês lambs, non-pregnant, non-lactating, seven animals of each coat color: black, brown and white, with an average initial weight of 25.71, 24.85 and 25.00 kg, for white, brown and black animals, respectively, and 12 months of age. The study was conducted during summer in the agreste region of Pernambuco State, Brazil. Twenty-one sheep were assigned to a completely randomized design with three treatments and seven replicates. The heat tolerance index and the animal performance were evaluated once a week for eight weeks. White sheep were slightly superior in heat tolerance to brown and black sheep, 88.3, 85.5 and 86.6 respectively, but this was not reflected in the growth performance of the animals, which showed average daily weight gain of 170.10, 193.69 and 199.50 g for animals white, brown and black, respectively.

Keywords: adaptation, bioclimatology, climate, heat stress.

Índice de tolerância ao calor, consumo alimentar e ganho de peso de ovinos da raça Santa Inês na região agreste do Estado de Pernambuco, Brasil

RESUMO. Os objetivos deste trabalho foram verificar a influência da cor do pelame na tolerância ao calor e ganho de peso de 21 cordeiras da raça Santa Inês, não-gestantes e não-lactantes, sendo sete de cada uma das pelagens preta, castanha e branca, com peso médio inicial de 25,71; 24,85 e 25,00 kg, respectivamente, para os animais brancos, castanhos e pretos e aproximadamente 12 meses de idade. Os experimentos foram conduzidos durante o verão na região agreste do Estado de Pernambuco, Brasil. O índice de tolerância ao calor e o desempenho dos animais foram avaliados uma vez por semana durante oito semanas. O delineamento experimental foi inteiramente casualizado com três tratamentos e sete repetições. Ovinos brancos apresentaram pequena superioridade na tolerância ao calor que os castanhos e pretos, 88,3; 85,5 e 86,6 respectivamente, mas isso não se refletiu no desempenho produtivo dos animais, os quais apresentaram ganho de peso médio diário de 170,10; 193,69 e 199,50 g para os animais brancos, castanhos e pretos, respectivamente.

Palavras-chave: adaptação, bioclimatologia, clima, estresse térmico.

Introduction

Environmental factors such as the climate can interfere with the animal performance, reducing the food consumption and weight gain of animals.

High temperatures and strong sunlight predominate during almost the whole year in arid regions and semi-arid region of Northeastern Brazil and may lead the animals to the caloric stress causing decline in production due to the drop in consumption of dry matter, as shown by several studies with sheep, even with animals of Santa Inês breed.

In tropical conditions, environmental factors are generally not compatible with the ideal range

of thermal comfort efficiency for optimal animal performance (PEREIRA, 2005). It would be ideal that determining the adaptability of an animal to a given environment had high correlation with the yield or growth performance. Adaptive characteristics are very important in the process of adjustment of the animal to the adverse weather conditions, and among them stands out the coat color that determines the amount of thermal radiation that the animal reflects and absorbs, which may change their caloric balance.

This study aimed to verify the influence of the coat color on the heat tolerance and pasture intake of Santa Inês sheep.

Material and methods

The survey was conducted from January to March 2008, in Riachão Farm, located in the municipality of Sairé, Agreste region of Pernambuco State. The rainfall in the region ranges from 600 to 900 mm year⁻¹, concentrated in the months from March to July, and the climate is dry sub-humid (CONDEPE, 1980).

The animals went through an adjustment period of 14 days to the management and diet and were kept in a 3 ha-paddock with pangola grass pasture (*Digitaria decumbens* Stent). The stocking rate was seven animals per hectare. The paddock was provided of a weir and natural shade.

The experiment lasted eight weeks with 21 Santa Inês lambs with 25 kg average weight and 12 months of age, being seven of each coat color: white, brown and black. The experiment consisted of a completely randomized design with three treatments and seven repetitions. At 6:00 AM, animals were released into a paddock without shading, and were given forage and water ad libitum. The rectal temperature (TR, °C) was obtained at 9:00 AM and 2:00 PM, which was measured with a clinical digital thermometer inserted into the rectum of the animal. After the data measurements in the afternoon, animals were released into the pasture and at 5:00 PM collected to the fold. For the calculation of the heat tolerance index we used the specific formula for sheep, proposed by Rauschenbach and Yerokhin, (1975): $ITC = 2 (0.5 t_2 - 10 dT + 30)$, where : ITC = heat tolerance index (dimensionless) ; T₂ = air temperature in the afternoon (3:00 PM); dT = difference between the body temperature in the afternoon and in the morning.

The results were analyzed by the software SAS (2005). It was evaluated the intake and the digestibility of dry matter (DM) and nutrients. Were used the following indicators chromic oxide and indigestible acid detergent fiber (FDAi) for estimating the forage dry matter intake and the apparent digestibility of dry matter and nutrients determined in the samples using the in "situ" degradability technique for 144h. From the concentration of chromic oxide in the faeces and the amount ingested by the animal, it was estimated the fecal excretion. Later, based on the concentration of FDAi of faeces and food, it was estimated the forage dry matter intake.

All animals were given, at the end of the afternoon in the fold, in individual feeders, concentrate prepared with soybean meal, ground

corn and mineral supplement, formulated according to the NRC (2007). Animals were weighed every week and the concentrate was supplied on the basis of 1% body weight (BW) with daily weighing of leftovers. The chromic oxide was supplied mixed with the concentrate, in the proportion of 2.88 % DM (dry matter), which was supplied twice a day, in individual troughs. Fecal samples were collected directly from rectal ampulla of ewe lambs at 6:00 AM and 5:00 PM in the last four days of the concentrate supply.

Results and discussion

Mean values of meteorological elements observed in the morning (8:00 AM) and afternoon (3:00 PM), are shown in Table 1.

Table 1. Values of meteorological elements by the morning (8h) and afternoon (15h) during the experimental period.

Schedule	Tbs	RH	WP
8h	24.9	76	1.7
15h	29.7	55	3.4

Tbs = Dry Bulb Temperature (° C), RH = Relative Humidity (mm), VV = wind speed (meters / second).

During the experimental period, it was observed values of rainfall of 71.0 mm (January), 35.0 (February) and 0.0 (March) and the minimum and maximum temperatures were 18 and 35°C respectively.

Table 2 lists the mean values and Pearson correlation coefficients between the heat tolerance index with total weight gain and average daily weight gain for Santa Inês sheep with different coat colors.

Table 2. Mean values and Pearson correlation coefficients between the heat tolerance index (ITH) with the total weight gain (TWG) and average daily weight gain (ADWG) for sheep of Santa Inês of different colors of coat.

	Coat Color					
	White		Brown		Black	
ITH*	88.3		85.5		86.8	
	TWG	ADWG	TWG	ADWG	TWG	ADWG
ITH*	-0.1256ns	-0.2994ns	0.0557ns	-0.2015ns	-0.2402ns	-0.2962ns

*CV= 3.5; ns = non-significant (p > 0.05). TWG = total weight gain; ADWG = average daily weight gain.

The ITH, considering the set of animals of the three coat colors, ranged from 58 to 116. Therefore there was a high variability in the tolerance to heat within the breed, a phenomenon also observed by Quesada et al. (2001) in a study with 25 females of the Morada Nova and Santa Inês breeds, aged between two and four years in the Federal District, Brazil under conditions of air temperature and relative humidity ranging from 12.0 to 32.2°C and 22 and 99%, respectively. The high variability in heat tolerance found in this study occurred in the

animals of the three coat colors, which allowed inferring the possibility of performing a selection within the breed to such trait.

No significant difference ($p > 0.05$) was detected in the rate of heat tolerance among animals of different coat colors. However, the white ones showed a slight superiority to the brown and black animals, which were similar to each other; these results confirm those obtained by Neves et al. (2009), who worked on the same property and time of year.

Also, no significant correlation ($p > 0.05$) was found between the heat tolerance index and the total and daily weight gain. The lack of a significant correlation between the tolerance and weight gain of sheep in the present study is probably due to the small difference among animals of the different coat colors, relative to the adaptability to heat, and also because sheep belonged to the same breed, originated in the conditions at which the study was carried out, and thus, with high adaptability to these stressful conditions. In this way, a single characteristic, such as the color, would be insufficient alone to cause great differences among the animals.

The mean values of intake of dry matter, of forage, of concentrate and total in g day^{-1} , are presented in Table 3.

Table 3. Estimate of daily consumption of dry matter, concentrate, and forage, and average daily weight gain in Santa Inês sheep of different coat colors.

Consumption	Coat			CV (%)	P > F
	White	Brown	Black		
Dry matter g day^{-1}	2.3	2.3	2.1	10.20	Ns
Concentrate g day^{-1}	0.95	0.94	0.95	1.28	Ns
Roughage g day^{-1}	1.32	1.41	1.15	17.73	Ns
Total g day^{-1}	2.27	2.35	2.10	10.20	Ns

CV (%) - coefficient of variation, % BW = percentage of live weight, * - weight as covariate in this analysis, P > F = Significance level by Fisher's test.

White, brown and black sheep have not differed ($p > 0.05$) in relation to the consumption of dry matter, concentrate, forage and average daily weight gain. The average daily weight gain was 170.10, 193.69 and 199.50 (g day^{-1}) for white, brown and black animals, respectively.

This is probably because animals are of the same breed, with genetic composition favorable to the environment at which they have been subjected to. The results suggested that the coat color is not a characteristic capable alone to impose changes in maintaining heat balance of Santa Inês sheep

enough to influence the growth performance of animals. On the other hand, these studies could be conducted with a larger number of animals.

Souza et al. (2011) evaluated the feeding behavior of Santa Inês sheep grazing in the semi-arid region of Paraíba State, distributed in environments without shadow (SS), natural shade (SN) and artificial shade (AS), and observed averages regarding maximum and minimum temperature of 35.17 to 20.67°C in the SN, 37.00 to 21.82°C in AS and achieved gains of 120.43, 113.1 and 129.32 g day^{-1} , respectively, and receiving increasing levels of concentrate supplementation, 0.0; 1.0 and 1.5 % body weight (BW), found values of 85.89, 114.36 and 162.60 g day^{-1} , respectively.

According to Neiva et al. (2004) Santa Inês sheep kept in the shade, have presented weight gain 30% higher (174 g day^{-1}) than those kept under direct solar radiation (122 g day^{-1}).

Conclusion

White sheep showed a slight superiority in heat tolerance in relation to brown and black animals, but this is not reflected in the productive performance of animals. From these results, it is suggested that more work should be done in order to strengthen our results.

References

- CONDEPE-Instituto de Desenvolvimento de Pernambuco. **Búfalo: uma alternativa para a pecuária em Pernambuco**. Recife, 1980.
- NEIVA, J. N. M.; TEIXEIRA, M.; TURCO, S. H. N. Efeito do estresse climático sobre os parâmetros produtivos e fisiológicos de ovinos Santa Inês mantidos em confinamento na região litorânea do nordeste do Brasil. **Revista Brasileira de Zootecnia**, v. 33, n. 3, p. 668-678, 2004.
- NEVES, M. L. M. W.; AZEVEDO, M.; COSTA, L. A. B.; GUIM, A.; LEITE, A. M.; CHAGAS, J. C. Níveis críticos do Índice de Conforto Térmico para ovinos da raça Santa Inês criados a pasto no agreste do Estado de Pernambuco. **Acta Scientiarum. Animal Sciences**, v. 31, n. 2, p. 169-175, 2009.
- NRC-National Research Council. **Nutrients requirements of small ruminants**. 6th ed. Washington, D.C.: NRC, 2007.
- PEREIRA, C. C. J. **Fundamentos de bioclimatologia aplicados à produção animal**. Belo Horizonte: FEPMVZ, 2005.
- QUESADA, M.; McMANUS, C.; D'ARAÚJO COUTO, F. A. Tolerância ao calor de duas raças de

ovinos deslanados no Distrito Federal. **Revista Brasileira de Zootecnia**, v. 30, n. 3, p. 1021-1026, 2001.

RAUSCHENBACH, J. O.; YEROKHIN, P. I. **Quantitative estimation of heat tolerance in animals**. Novosibirsk: Publishing House NAUKA; Siberian Branch, 1975.

SAS-Statistical Analysis System. **User's guide**: Statistics, version 6.11. Cary: SAS Institute, 2005.

SOUZA, B. B.; ANDRADE, I. S.; PEREIRA FILHO, J. M. Efeito do ambiente e da suplementação no

comportamento alimentar e no desempenho de cordeiros no semiárido. **Revista Caatinga**, v. 24, n. 1, p. 123-129, 2011.

Received on August 30, 2012.

Accepted on November 19, 2012.

License information: This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.