Thermorespiratory Response of West African Dwarf Does to Progestagen Injection

G.N. Egbunike[1], S.I.Ola[2],*, K.R. Adegboye[2], H.A. Abe[2] & F.A. Ogundana[2]

Keywords: Progestagens- Rectal temperature- Respiration rate- West african dwarf does

Summary

The physiological responses in terms of respiration rate (RR) and rectal temperature (RT) of 30 West African Dwarf (WAD) does were monitored after a single im injection of different doses of progestagens meant for synchronising oestrus. The treatments involved im injection of 1) 2 ml of sterile water (Control); 2) 25 mg Medroxy Progesterone Acetate, MPA; 3) 50 mg MPA; 4) 50 mg Progesterone and 5) 100 mg progesterone. The RR and RT of each animal were measured at 9:00, 13:00 and 17:00 h for 21 days after each injection. In all the treatment groups the RT did not change significantly (P> 0.05) during the weeks following treatment. On the contrary the RR was significantly higher (P< 0.05) in the week after injection than in the pre-injection period. Both the RR and the RT were higher at 13:00 h and 17:00 h than at 9:00 h. The RR was more influenced by the animal body size than the RT, while the ambient temperature and humidity affected both the animal's RT and RR. These results indicate that the thermorespiratory function of WAD does under their native humid environment is not negatively affected by injecting ≤ 100 mg progesterone or ≤ 50 mg MPA to synchronize oestrus.

Résumé

Réponse thermorespiratoire de la chèvre naine ouest-africaine à l'injection de progestatif

Les réponses physiologiques en terme de taux de respiration (RR) et de température rectale (RT) de 30 chèvres naines ouest-africaines sont contrôlées après injection unique de différentes doses de progestatif dans l'intention de synchroniser l'oestrus. Les traitements sont une injection im de: 1) 2 ml d'eau stérilisée (servant de témoin); 2) 25 mg d'Acétate de Medroxyprogestérone, MPA; 3) 50 mg MPA; 4) 50 mg de progestérone; et 5) 100 mg de progestérone. Le taux de respiration et la température rectale de chaque animal étaient mesurés respectivement à 9:00, 13:00 et 17:00 h pendant 21 jours après chaque injection.
Dans tous les traitements, la température rectale n'a pas varié de façon significative (P> 0,05) dans les semaines qui ont suivi le traitement. Au contraire le taux respiratoire était plus élevé (P< 0,05) dans la semaine après injection que dans celle avant l'injection. Aussi bien le taux respiratoire que la température rectale étaient plus élevés à 13:00 et 17:00 h qu'à 9:00 h. Le taux de respiration était plus influencé par le gabarit de l'animal que la température rectale ne l'était. Cependant, la température ambiante et l'humidité influençaient aussi bien la température rectale que le taux de respiration de l'animal. Ces résultats indiquent que la fonction thermorespiratoire de la chèvre naine ouest-africaine dans son milieu naturel n'est pas négativement influencée par des injections de ≤ 100 mg de progestérone ou de ≤ 50 mg d'Acétate de Medroxyprogestérone destinées à synchroniser l'oestrus.

Introduction

Many exogenous factors such as ambient temperature and humidity (4, 10), day length (14) and therapeutic chemicals (18) affect the normal physiological functions of animals. Thus, observable behavioural changes such as augmentation of aggression, increased vocalization, apathy and biological changes such as frothing, increased respiration rate, anorexia and increased body temperature are reliable indicators of impaired well-being of animals. Polydipsia, depression and elevated blood glucose resulting from progestagen treatments have been reported in the bitch and the queen (8, 11). Also in the report covering 1997 and 1998, the Australian " National Registration Authority for Agricultural and Veterinary Chemicals" reported that chorionic gonadotropin + progesterone and oxytocin caused a total of 5 product-related deaths in cattle after intravenous injection (15).
In the humid tropics a major problem confronting

[1]Department of Animal Science, University of Ibadan, Ibadan, Nigeria.
[2]Department of Animal Science, Obafemi Awolowo University, Ile-Ife, Nigeria.
*Corresponding author: Department of Animal science, Obafemi Awolowo University, Ile-Ife, Nigeria. E-mail: sola@oauife.edu.ng Phone: +234 803 4053035
Received on 26.04.04. and accepted for publication on 18.08.04.

Table 1
Initial liveweight, age and parity of the randomized animals

Treatment	Control	25 mg MPA	50 mg MPA	50 mg Progesterone	100 mg Progesterone
n	5	7	6	7	5
Liveweight (kg)	14.3 ± 4.6[a]	9.4 ± 2.1[b]	12.3 ± 3.4[b]	10.8 ± 3.7[b]	15.2 ± 2.6[a]
Parity	3.6 ± 2.2	3.4 ± 2.3	3.6 ± 2.8	3.5 ± 2.5	3.8 ± 2.2
Age (years)	3.8 ± 2.9	4.0 ± 2.1	3.9 ± 2.0	4.2 ± 3.0	3.9 ± 2.8

Values (mean ± SD) with different superscript within a row differ significantly (P< 0.05)

animal production is that of heat stress as a result of the all-year-round high ambient temperature and relative humidity (17). Therefore, any innovation in animal agriculture should at least not add to the heat load on the animals in this region. Progestagens are administered to livestock for many reasons including therapeutic and prophylactic purposes. The aim of this study was to determine whether the intramuscular administration of progestagens for oestrus synchronization would upset the thermorespiratory balance of the animals under the warm humid climate of Ile-Ife, Nigeria. The respiration rate (RR) and the rectal temperature (RT) were determined in West African Dwarf (WAD) does following the intramuscular injection of progestagens.

Materials and methods

Experimental site, period and animals

The study was conducted at the goat unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria which is situated between 7° 28' N and 4° 33' E at an altitude of 240 m above sea level. The experiment lasted 28 rain-free days between 10th February and 9th March 2002, a period depicted as late dry season (6). The mean daytime air temperature and humidity within the barn during this period were monitored.

The experimental animals used were 30 non-pregnant WAD does aged between 1.5–5 years and varied in parity from 0-6. During the experimental period, the animals were permanently confined to the pens and fed in groups of 3 per pen with *Panicum maximum* and *Gliricidia sepium* forage *ad libitum* supplemented with 150 g/day/animal of ration. The ration contained 35% corn offal, 40% palm kernel cake, 23% wheat offal, 1% bone meal, 1% oyster shell, 0.25% common salt and 0.1% vitamin/mineral premix. Water was also supplied daily. After 4 weeks of adaptation, the animals were randomly allotted with respect to parity and age to the 5 treatment groups (Table 1).

Experimental treatments, data collection and statistical analyses

The treatments involved once im injection of progestagen as an oestrus synchronizing agent, in the lumbosacral area. The treatments were:

Treatment SH_2O - 2 ml of sterile water (control)
Treatment 25 MPA - 25 mg Medroxy-progesterone-acetate, MPA, (Depo-Provera®, Upjohn) in aqueous suspension
Treatment 50 MPA - 50 mg MPA in aqueous suspension
Treatment 50 PROG - 50 mg progesterone (Longlife, China) in oil suspension
Treatment 100 PRO - 100 mg progesterone in oil suspension

Measurement of the RR and the RT in all animals commenced 7 days before injection and continued for 21 days after injection.The RR and the RT of each animal were measured simultaneously thrice daily between 9:00-10:00 h, 13:00-14:00 h and 17:00-18:00 h throughout the 28 days of the experiment. The RR was determined by counting the number of thoracoabdominal excursions (flank movements) of a restrained doe over two 15-second periods (3, 20). The RT was measured with a clinical thermometer inserted into the rectum to a depth of about 3 cm for at least 2 minutes. During the observation period dry and wet bulb temperatures (DT and WT respectively) within the barn were recorded simultaneously with the measuring of the physiological parameters. The relative humidity (RH) was calculated from the dry and wet bulb temperatures using the automatic humidity reader from http://www.bom.gov.au/lam/humiditycalc.shtml. The data obtained from the RR and the RT measurements were analysed for variance using the GLM procedure of the SAS (19) software. Regression and correlation analyses were also run between the physiological variables and the climatic variables or metabolic body size ($BW^{0.75}$) of the does.

Results

Effect of progestagen treatment on thermorespiratory variables

As set out in table 2, the mean daytime RT of the animals in any of the treatment groups after the injection i.e. week 2 to 4, was not different (P> 0.05) from the pre-injection i.e. week 1 values.

However, when compared for the different periods of the day the RT was lower at 9:00 h (morning) than at 13:00 h (early afternoon) and 17:00 h (late afternoon)

Table 2

Rectal temperature (°C) of WAD does after progestagen injection

Treatment	Control	25 mg MPA	50 mg MPA	50 mg Progesterone	100 mg Progesterone
Week of study					
1	39.1 ± 0.3	39.4 ± 0.3	39.0 ± 0.3	39.9 ± 0.9	39.3 ± 0.3
2	39.2 ± 0.4	39.4 ± 0.4	39.1 ± 0.3	39.4 ± 0.3	39.2 ± 0.3
3	38.9 ± 0.2	39.1 ± 0.3	38.8 ± 0.2	39.2 ± 0.3	39.1 ± 0.2
4	39.1 ± 0.2	39.0 ± 0.3	38.9 ± 0.2	39.1 ± 0.3	39.2 ± 0.2
Time of day					
9:00 h	38.7 ± 0.1^{A,b}	38.7 ± 0.1^{A,b}	38.5 ± 0.02^{B,b}	38.8 ± 0.1^{A,c}	38.7 ± 0.04^{A,b}
13:00 h	39.2 ± 0.04^{AB,a}	39.4 ± 0.1^{A,a}	39.0 ± 0.1^{B,a}	39.4 ± 0.1^{A,b}	39.2 ± 0.1^{AB,a}
17:00 h	39.3 ± 0.1^{C,a}	39.7 ± 0.1^{B,a}	39.3 ± 0.1^{C,a}	40.2 ± 0.6^{A,a}	39.5 ± 0.1^{BC,a}

Values (mean ± SD) with different superscript within a row (^{A,B,C}) or column (^{a,b,c}) in either groupings differ significantly (P< 0.05)

Table 3

Respiration rate (pants/min) of WAD does after progestagen injection

Treatment	Control	25 mg MPA	50 mg MPA	50 mg Progesterone	100 mg Progesterone
Week of study					
1	82.9 ± 12.2^{A,b}	86.5 ± 17.8^{A,c}	87.2 ± 18.3^{A,c}	89.1 ± 16.7^{A,c}	66.6 ± 8.5^{B,c}
2	122.5 ± 24.7^{B,a}	136.8 ± 40.0^{AB,a}	140.4 ± 35.8^{A,a}	136.2 ± 31.3^{AB,a}	98.4 ± 21.2^{C,a}
3	113.6 ± 14.7^{AB,a}	124.6 ± 31.5^{A,ab}	92.0 ± 29.6^{C,c}	103.5 ± 17.5^{BC,b}	100.6 ± 13.9^{BC,a}
4	111.3 ± 16.8^{A,a}	113.2 ± 25.8^{A,b}	109.5 ± 26.3^{A,b}	99.8 ± 18.2^{A,bc}	83.0 ± 7.3^{B,b}
Time of day					
09:00 h	74.8 ± 5.5^{b}	58.5 ± 2.4^{b}	66.1 ± 5.5^{c}	66.5 ± 3.3^{b}	63.6 ± 4.8^{b}
13:00 h	131.5 ± 12.7^{A,a}	144.7 ± 13.7^{A,a}	150.1 ± 13.9^{A,a}	134.1 ± 13.5^{A,a}	106.3 ± 1.8^{B,a}
17:00 h	116.4 ± 8.8^{B,a}	142.8 ± 17.9^{A,a}	106.7 ± 25.0^{BC,b}	120.9 ± 14.6^{B,a}	91.8 ± 9.7^{C,a}

Values (mean±SD) with different superscripts within a row$^{(A,B,C)}$ or column$^{(a,b,c)}$ in either groupings differ significantly (P< 0.05)

in all treatment groups. The RT at 13:00 h and 17:00 h was usually not different except for animals in the 50 PROG group that had a higher (P< 0.05) RT at 17:00 h. There were also significant variations in the RT between the treatments at each time period of measurement.

The lowest RT value was obtained at 09:00 h in the 50 MPA group (38.5 ± 0.02 °C) while the highest value occurred in the 50 PROG group at 17:00 h (40.2 ± 0.6 °C).

Table 3 represents the RR of the treatment groups compared between the weeks and the time of the day during the entire study period.

In all the treatments including the control the RR was significantly higher (P< 0.05) in the immediate week after injection (week 2) than in the pre-injection (week 1) period. It was also noted that the increased RR values remained so throughout the study in treatments 25 MPA, 100 PROG and in the control. In the 50 MPA and the 50 PROG treatments the values for the third

Table 4

Diurnal variation in the climatic variables during the experiment

Parameter	9:00 h	13:00 h	17:00 h	Daytime mean
Dry bulb temp. (°C)	27.9 ± 0.3^{b}	36.5 ± 0.3^{a}	36.2 ± 0.4^{a}	33.0 ± 4.8
Wet bulb temp. (°C)	27.0 ± 0.3^{b}	34.1 ± 0.6^{a}	35.1 ± 0.5^{a}	31.9 ± 4.4
Relative humidity (%)	93.0 ± 1.2^{a}	84.1 ± 0.9^{b}	93.1 ± 1.8^{a}	91.0 ± 5.1

^{a,b}Values (mean ± SD) within a row, excluding the mean, with different superscripts differ significantly (P< 0.05).

Table 5
Relationship between the physiological variables and the climatic variables or metabolic body size in WAD does

Dependent (Y)	Regression equation	Independent (X)	r	R^2
Rectal temperature	Y= 35.70 + 0.10X	Dry bulb temperature	0.72**	0.52
	Y= 36.43 + 0.08X	Wet bulb temperature	0.70**	0.49
	Y= 307.91- 7.51X	Metabolic body size	-0.44	0.19
Respiration rate	Y= -186.3 + 8.99X	Dry bulb temperature	0.65**	0.42
	Y= -115.3 + 7.10X	Wet bulb temperature	0.60**	0.36
	Y= 24.21 - 0.09X	Metabolic body size	-0.59**	0.35

** P< 0.01 r= coefficient of correlation R^2= coefficient of determination

(92.0 ± 29.6 pants/min) and fourth (99.8 ± 18.2 pants/min) weeks respectively were not different from their pre-injection values (87.2 ± 18.3 and 89.1 ± 16.7 pants/min respectively). Comparing the RR at different times of the day revealed that irrespective of the treatment the RR was always lower in the morning (9:00 h) than in the early (13:00 h) or late afternoon (17:00 h) while there was no difference (P> 0.05) between the latter two, except in treatment group 50 MPA (150.1 ± 13.9 and 106.7 ± 25.0 pants/min respectively, P< 0.05). RR values also varied significantly between treatments at 13:00 and 17:00 h, but not at 9:00 h periods.

Effect of climatic variables on thermorespiratory variables

The mean daytime values for the DT, the WT and the RH within the barn during the 28 days of the study were 33.0 ± 4.8 °C, 31.9 ± 4.4 °C and 91.0 ± 5.1% respectively (Table 4).

Both the DT and WT were significantly lower (P< 0.05) at 9:00 and 13:00 h than at 17:00 h, whereas the RH at 9:00h (93.0 ± 1.2%) and 17:00 h (93.1 ± 1.8%) was higher than the 13:00 h reading (84.1 ± 0.9%). The correlation coefficients as well as the regression equations between the climatic variables (DT and WT) and the thermorespiratory variables (RT and RR) for the pooled experimental does are set out in table 5.

The RT was significantly (P< 0.01) more related to the DT (r= 0.72) and WT (r= 0.70) than the RR (0.65 and 0.60 respectively). Also the DT accounted for the majority of the variations in the RT (R^2= 0.52) and RR (R^2= 0.42). However both the RT (r= -0.44) and the RR (r= -0.59) showed negative relationships to the animal metabolic size.

Discussion

The ranges of the RR and the RT values of the WAD goats during this experiment agreed with the normal range already reported for the same breed under various climatic conditions (5, 12, 16). This suggests that the animals were apparently healthy and not stressed during the study. While the RR of the does increased significantly after the injections, the animals were still able to maintain their RT throughout the study. The increase in the RR could not be associated with the progestagen injection since the control group was also affected. It may have been due to the slight rise in the mean daytime ambient temperature during week 2 (33.4 ± 4.8 °C) compared to that of week 1 (31.9 ± 4.8 °C). This could be confirmed by the fact that both the RT and the RR under the various injections fluctuated diurnally in response to the diurnal variation in the DT. However both variables (RR and RT) were still within the range reported by earlier workers (5, 12, 16). Panting serves as the control mechanism for keeping the body heat production of heat stressed animals under control (17). This mechanism is very vital to the efficiency and survival of tropical animals (1, 4, 9). The observations in the present study confirm the earlier assertions that except in the case of infection (23), low energy intake (2) and heat stress (5, 13) WAD goats, as homeotherms, will maintain their body temperature within a normal range of between 38.5 and 39.7 °C.

The dry-bulb temperature is more important than the wet-bulb temperature in determining the thermal stress to animals in the tropics (4, 5, 22). This was also confirmed in the present study, as higher correlation coefficients were obtained between the DT and the thermorespiratory variables than between the WT and these variables. Under the high ambient temperature (30-40 °C) and relative humidity (> 70%) of the humid tropics goat pants to reduce the heat load on the body (5, 21). The heat load will be lesser in larger animals than in smaller ones since the former are able to dispose of more heat through sweating and conduction (17). This would explain the negative relationship obtained between the metabolic size and the thermorespiratory variables and also the lower RR of the 100 PROG group at 13:00 h and 17:00 h compared to other treatment groups at the same time. Regression equations and correlation coefficients obtained in our study therefore supported the established positive relation between the RR or the RT and the ambient temperature and the negative relation between the RR or the RT and the animal body size. Ahmed and El-Amin (1) obtained similar equations and relations in Zebu cows in the dry tropical Sudan. Hamzat (7) further showed that the thermal comfort of the WAD goats under humid conditions is improved by shearing.

Conclusion

The results of our study suggest that intramuscular injection of 50 mg of MPA or 100 mg of progesterone for oestrus synchronisation in WAD goats does not constitute to heat stress in the animal. The climatic variables, most especially the ambient temperature and the relative humidity, and the animal body size, are more important in determining heat stress in the WAD does under the humid conditions.

Acknowledgment

We thank Dr R. Kassali of the Department of Agricultural Economics, Obafemi Awolowo University, Ile-Ife, Nigeria for the translation of the abstract to French.

Literature

1. Ahmed M.M.M. & El Amin A.I., 1997, Effect of hot dry summer tropical climate on forage intake and milk yield in Holstein-Friesian and indigenous zebu cows in Sudan. J. Arid Enviro. 35, 737-745.
2. Akinbamijo O.O., van Dam J.T., Tolkamp B.J. & Zwart D., 1996, The effect of level of energy intake on rectal temp and maintenance requirement of West African Dwarf goats. Vet. Quart. 18, 26-28.
3. Ames D.R. & Arehart L.A., 1972, Physiological responses of lambs to auditory stimuli. J. Anim. Sci. 34, 994-997.
4. Egbunike G.N., 1979, The relative importance of dry- and wet-bulb temperatures in the thermorespiratory function in the chicken. Zbl. Vet. Med. A. 26, 573-579.
5. Egbunike G.N. & Bitto I.I., 1999, Effects of season on the physiological responses of the West African dwarf buck exposed to acute tropical sunlight. Trop. Anim. Prod. Invest. 2, 19-27.
6. Egbunike G.N. & Steinbach J., 1979, Seasonal variations in the sperm production rates of boars in a humid tropical environment. Nigerian. J. Agric. Sci. 1, 21-26.
7. Hamzat R.A., 1998, The effect of shearing on the response of goats in humid tropics. M.Sc thesis, Department of Animal Science, University of Ibadan, Ibadan, Nigeria. 98 p.
8. Hart B.L., 1980, Objectionable urine spraying and urine marking in cats: evaluation of progestin treatment in gonadectomised males and females. J. Am. Vet. Med. Assoc. 177, 529-533.
9. Johnson K.G., 1970, Sweating rate and the electrolyte content of skin secretions of *Bos taurus* and *Bos indicus* crossbred cows. J. Agric Sci., Cambrigde, 75, 397-411.
10. Johnson K.G., 1971, Body temperature lability in sheep and goat during short-term exposures to heat and cold. J. Agric. Sci. Cambrigde, 77, 267-272
11. Middleton D.J. & Watson A.D. 1985, Glucose intolerance in cats given short-term therapies of prednisolone and megestrol acetate. Am. J. Vet. Res. 46, 2623-2625.
12. Montsma G. & Hofs P., 1985, Physiological reaction of West African Dwarf goats to various ambient temperatures. Personal communication.
13. Montsma G., Luiting P., Verstegen M.W.A., Hel W., Hofs F. & Zulker J.W., 1985, Effects of high ambient temperatures on the metabolism of West African Dwarf goats. Int. J. Biometeor, 29, 23-35.
14. Newbold J.A., Chapin L.T., Zinn S.A. & Turker H.A., 1991, Effects of photoperiod on mammary development and concentration of hormones in serum of pregnant dairy heifers. J. Dairy Sci. **74**,1, 100-108.
15. National Registration Authority, NRA, 1999, Report of adverse experiences, 1997/1998. National Registration Authority for Agricultural and Veterinary Chemicals. http://www.nra.gov.au/qa/aer9798.pdf.
16. Ogebe P.O., Ogunmodede B.K. & McDowell L.R., 1996, Behavioural and physiological responses of Nigerian dwarf goats to seasonal changes of the humid tropics. Small Rum. Res. **22**, 3, 213-217.
17. Pagot J., 1992, Animal production in the tropics and subtropics. Macmillan, London, 517 p.
18. Romagnoli S. & Concannon P.W., 2003, Clinical use of progestins in bitches and queens: a review, *in*: Concannon P.W., England G., Verstegen J. & Linde-Forsberg C. (editors), Recent advances in small animal reproduction. IVIS, New York, USA. http://www.ivis.org/docA1206.0903.
19. Statistical Analysis System, SAS, 1997, SAS Inc, Carry, North Carolina, 1997 edition.
20. Simms R.H., 1971, Respiratory rates and rectal temperature in the newborn lamb. J. Anim. Sci. 32, 296-300.
21. Singh K. & Saxena S.K., 1995, Heat tolerance in three breeds of Indian goats. Indian Vet. J. 72, 466-468.
22. Steinbach J., 1971, Relative effects of temperature and humidity on thermal comfort in swine. Nigerian. Agric. J. 8, 132-134.
23. van Miert A.S., van Duin C.T. & Wensing T., 1992, Fever and acute phase response induced in dwarf goats by endotoxin and bovine and human recombinant tumour necrosis factor alpha. J. Vet. Pharmacol. Ther. 15, 332-342.

G.N. Egbunike, Nigerian, Ph.D., Professor of Animal Physiology, Department of Animal Science, University of Ibadan, Ibadan, Nigeria.

S.I. Ola, Nigerian, MSc., Lecturer in Reproductive Physiology, Department of Animal Science, Obafemi Awolowo University, Ile-Ife, Nigeria, *Corresponding author: Department of Animal science, Obafemi Awolowo University, Ile-Ife, Nigeria. E-mail:sola@oauife.edu.ng Phone: +234 803 4053035.

K.R. Adegboye, Nigerian, B.Agric (Hons) (Animal Science), Graduated in Sept 2002 from the Department of Animal Science, Obafemi Awolowo University, Ile-Ife, Nigeria.

H.A. Abe, Nigerian, B.Agric (Hons) (Animal Science), Graduated in Sept 2002 from the Department of Animal Science, Obafemi Awolowo University, Ile-Ife, Nigeria.

F.A. Ogundana, Nigerian, B.Agric (Hons) (Animal Science), Graduated in Sept 2002 from the Department of Animal Science, Obafemi Awolowo University, Ile-Ife, Nigeria.