REVISTA ENERGIA NA AGRICULTURA

ISSN: 1808-8759 (cd-rom)
2359-6562 (on-line)

PIGLET BEHAVIOR INFLUENCED BY ARTIFICIAL LIGHT DURING NURSERY PERIOD

Vilmar Rodrigues de Sousa Junior[1], Paulo Giovanni de Abreu[2], Osmar Antônio Dalla Costa[3], Letícia dos Santos Lopes [4] & Luana Araujo Sabino[5]

ABSTRACT: This study aimed at assessing the behavioral pattern of animals influenced by schedules of light during the nursery period. The experiment was conducted at the Embrapa Swine and Poultry. The treatments were associated with the room light, with a different treatment at each room: Program NL – natural light (control); Program 16L:8D – artificial light for 16 hours and dark for 8 hours a day; Program 23L:1D – artificial light for 23 hours and dark for 1 hour a day. The behavior of the piglets was taped for 24 hours during the first week. The schedules were split into shifts: morning (06:00 to 12:00), afternoon (13:00 to 18:00) and night (19:00 to 05:00), and the behavior was evaluated through an ethogram. The piglets presented different behavior in the distinct schedules of light, but without a clear pattern during the nursery period. Since other studies have pointed out contradictory results, it is required further studies on this subject.

KEYWORDS: Ethogram, welfare, light.

PADRÕES DE COMPORTAMENTO DE LEITÕES NA FASE DE CRECHE INFLUENCIADOS PELA ILUMINAÇÃO ARTIFICIAL

RESUMO: Objetivou-se com este trabalho avaliar o padrão comportamental dos animais influenciados por programas de luz na fase de creche. O experimento foi realizado na Embrapa Suínos e Aves. Os tratamentos foram associados à iluminação da sala, sendo em cada sala aplicado um tratamento diferente: Programa LN – iluminação natural (controle); Programa 16L:8E – programa de iluminação artificial de 16 horas diárias de luz e 8 horas de escuro e Programa 23L:1E – programa de iluminação artificial de 23 horas diárias de luz e 1 hora de escuro. Os comportamentos dos suínos foram gravados na primeira semana durante 24 horas por dia. Os horários foram divididos em turnos, sendo: manhã (06:00 às 12:00), tarde (13:00 às 18:00) e noite (19:00 às 05:00) e os comportamentos avaliados por meio de etograma. Os leitões nos programas de iluminação avaliados apresentaram comportamentos diferenciados não tendo um padrão na fase de creche. Como existem resultados contraditórios em outros estudos, é necessário que se realizem outras pesquisas acerca do assunto.

PALAVRAS-CHAVE: Etograma, leitões, luz.

[1] Universidade Estadual de Campinas - Faculdade de Engenharia Agrícola/FEAGRI. E-mail: sousajunior.vilmar@hotmail.com
[2] Engenheiro Agrícola, D.Sc., pesquisador da Embrapa Suínos e Aves. E-mail: paulo.g.abreu@embrapa.br
3 Zootecnista, D.Sc., pesquisador da Embrapa Suínos e Aves. E-mail: osmar@embrapa.br
[4] Estatística, analista , D.Sc., pesquisador da Embrapa Suínos e Aves. E-mail: leticialopes@embrapa.br
[5] Zootecnista, doutoranda pela Faculdade de Engenharia Agrícola – FEAGRI, UNICAMP. E-amil: luana_as@hotmail.com

1 INTRODUCTION

Brazilian pig farming has gained prominence in the international agricultural sector owing to, among other aspects, low production costs. This activity is performed staggered over time with a small profit margin, not considering the individual care to the animals. Their suffering may result from physical or psychological deprivation in confinement, such as: lack of space, social isolation, and inability to move, among others (CAMPOS et al., 2009).

This intensification of pig farming has been successful in reducing production costs, and consequently providing cheaper products to the consumer. However, some questions have been raised by the consumers as how this farming system affects the welfare of the animals. People want to consume meat with 'ethical quality', that is, meat from animal reared, handled, and slaughtered in systems that promote welfare and that are sustainable and environmentally friendly (FRASER, 2001).

Researches on methodologies that improve economic results are very important, but attention should also be given to the welfare of animals, given the increasing demand of the consumer market. The behavior analysis is a way to check the comfort or discomfort of the animals to the environment, and this is currently performed by image analysis. This assessment and the interactive controls of thermal comfort of pigs by image analysis outweigh the problems caused by the conventional method of observation, since the own animals are used as biosensors, in response to environmental variations through behavioral study (SILVA et al., 2004), reducing the external influence on the observed results.

The new regulations (PORTUGAL, 2003) that deal with issues of animal welfare mention the use of artificial light in pig farming, requiring the exposure to an intensity of at least 40 lux for a minimum of 8 hours a day, in order to avoid the practice of some farmers that keep the animals in the dark to prevent fights and competitions. Lighting plays a key role in animal welfare (BALDWIN, 1979) and is related to basic needs like food, water, and heat. Daily rhythms of animal activity are strongly influenced and determined by light conditions within 24 hours. Although the endogenous circadian rhythm is influenced by external factors, including light, the literature is scarce concerning the effects of light on swine (AGUGGINI et al., 1992). In this way, this study evaluated the behavior of animals influenced by different schedules of light during the nursery period.

2 MATERIAL AND METHODS

The experiment was developed at the Embrapa Swine and Poultry, in the municipality of Concórdia, western Santa Catarina State. The rooms were east-west oriented and were 5.0 m long, 4.8m wide, with wooden ceiling at 2.4m high. These rooms were divided into two stall rows, with three 1.9 x 1.0 m units on each side, with inner and outer metal walls of 0.80m height, and polyethylene floor suspended at 0.50m height. Each stall had a tube feeder and nipple drinker. The heating of the rooms was obtained by using gas heaters, aiming to maintain the temperature close to 24-26 ºC (AMARAL et al., 2006) during the stay of the piglets in the nursery. The experimental diet was given ad libitum and based on corn, soybean meal, dairy by products, supplemented with minerals, vitamins, and additives, as required for the nursery phase (ROSTAGNO et al., 2005).

The experiment consisted of a completely randomized blocks design, with three treatments, six replications per treatment, and two periods of collection. The periods comprised two winters and two summers in 2008 and 2009. The blocks (stalls) were defined considering sire, weight, and position of the stall inside the rooms (treatments). The experimental unit was made up by a stall with six piglets each, with a heterogeneous number of male and female. It was used six stalls per treatment, three on each side of the room, totaling 36 piglets in each treatment, and 108 piglets per experimental period. The animals resulted from crossing Landrace x Large White females and MS 115 males, weaned at 28,3 ± 2,1 days old, and 9 ± 1,2 kg, according to the farm management. The treatments were associated with room lighting, with a different treatment at each room: Program NL – natural light (control); Program 16L:8D – artificial light for 16 hours and dark for 8 hours a day; Program 23L:1D – artificial light for 23 hours and dark for 1 hour a day. The schedules were split into shifts: morning (06:00 to 12:00), afternoon (13:00 to 18:00) and night (19:00 to 05:00).

Every room had three windows on the northern side and two windows on the southern side, used for air circulation and sunlight entry. On the hallway of the treatment rooms 23L:1D and 16L:8D, two 100 W-lamps were installed, source of artificial light, which were automatically switched on and off by a timer. The light intensity (lux) was measured within the treatments once a week, every three hours. For this measure, it was used a light meter Instrutherm (LD-209) accurate to ± 5%.

The recording of images for behavioral analysis of the piglets was performed by analog infrared cameras with 300 lines of horizontal resolution, with minimum sensitivity of one lux, 12 V voltage at 180 mA, and a converging lens of 2.45 mm. The infrared cameras were used to record the animals in the dark.

Two cameras were used in each treatment, responsible for recording three stalls each. The images were collected every day on the first week of the piglets in the nursery, at times of 0 to 24 hours, allowing continuous taping of images throughout the observation period. These images were managed by the software GEOVISION GV 800. As a criterion for image analysis, the behaviors were instantaneously evaluated every five minutes for 24 hours, seven days a week. To this end, all the animals in the stalls were evaluated, by analyzing the percentage of variation of the behavioral categories. The behaviors in question were assessed through an

ethogram according to studies developed by Dudink et al.(2006), Guy et al. (2002), Sondergaard et al. (2007) and Taylor et al. (2006) (Table 1).

Table 1 - *Ethogram of behavioral categories of piglets during nursery period*

Category	Specific Category	Definition
Inactive	Lying agglomerated	Piglets lying, with bodies in contact with each other
	Lying alone	Lying with legs under the body (ventral) and/or horizontally stretched, and may be involved in a different behavior, e.g., sniffing the ground
	Sitting	Support on the forelimbs and sit on the hind limbs
Active	Exploring the environment	Horizontal movements of the head on the floor (sniffing the ground); licking, biting, or manipulating the content of the stall
	Social Interaction	Subtle movements with the head/snout of one piglet toward another; different from a fight
	Eating feed	Piglet with the head next to the feeder
	Drinking	Piglet with the head next to the feeder
Agonistic interaction	Fighting	Any behavior indicating social conflict like: chase, bite, push head to head. The interaction may result in injuries on the body of the involved animals

Data were analyzed by means of the repeated measures model, using the procedure MIXED of SAS (2003), being tested 15 structures of variance and covariance, selecting the one with the lowest value according to the Akaike's Information Criterion (AIC). It was tested the effects of block, shift, year, year season, treatment, and interaction up to the third level. The unfolding of the treatment effect was done by a t-test.

3 RESULTS AND DISCUSSION

Lighting

The lighting average results of the schedule treatments on the first week of piglets in the nursery period are listed in Table 2.

Significant differences ($p<0.05$) were detected between the treatments, with the higher mean values observed for the schedules with longer artificial lighting (Table 2).

Table 2 - *Mean, standard-error and probability level of F-test per treatment and season for the lighting values (lux) on the first week in the nursery.*

Season	NL	23L:1D	16L:8D	Pr>F
Winter	1.56±0.52 c	34.54±1.39 a	25.38±0.37 b	<0.0001
Summer	8.10±2.29 c	52.44±2.26 a	39.58±2.72 b	<0.0001

Mean values followed by different letter in the row, within each season, are significantly different by t-test ($P<0.05$)

Behavior

For the behavior Exploring the Environment (EE), significant differences were found in both seasons, when the program 23L:1D had the lowest percentage values, except in the first shift in the winter, and the programs 23L:1D an 16L:8D presented lower values than the program NL. A similar trend was verified for the behavior Eating Feed (EF), with significant differences only in the summer, being the lowest values observed in the program 23L:1D in all seasons when compared with the other two programs (Table 3). Eating Feeder and the feeder and drinker, respectively, but not necessarily eating and drinking.

Table 3 - *Mean, standard-error and probability level of F-test of the percentage of behaviors per shift, treatment, and season on the first week of the piglets in the nursery.*

	Winter			Summer		
Shift	**NL**	**23L:1D**	**16L:8D**	**NL**	**23L:1D**	**16L:8D**
Exploring the Environment (EE)						
Morning	16.45±0.80**a**	12.52±1.25**b**	12.22±0.94b	12.11±0.26**a**	7.96±1.45**b**	12.09±1.08**a**
Afternoon	21.19±1.05**a**	15.53±1.39b	19.97±0.84a	15.33±1.16**a**	8.95±1.753**b**	15.06±1.81**a**
Night	2.56±0.35	2.76±0.14	2.98±0.28	2.39±0.25**a**	1.34±0.32**b**	2.71±0.25**a**
Drinking Water (DW)						
Morning	0.50±0.11**ab**	0.75±0.16**a**	0.26±0.05**b**	0.26±0.06	0.19±0.06	0.28±0.03
Afternoon	0.37±0.06**b**	1.06±0.19**a**	0.56±0.21**b**	0.50±0.10	0.27±0.09	0.39±0.08
Night	0.05±0.02**b**	0.21±0.05**a**	0.13±0.04**b**	0.03±0.01	0.03±0.01	0.04±0.01
Eating Feed (EF)						
Morning	20.88±1.28	18.16±0.83	16.29±1.03	17.30±1.04**a**	12.23±2.20**b**	17.55±0.53**a**
Afternoon	22.71±0.89	20.73±1.13	23.76±0.94	23.32±0.84**a**	15.68±2.79**b**	20.87±0.60**a**
Night	3.01±0.61	3.58±0.41	3.70±0.76	4.15±0.52**a**	1.88±0.61**b**	4.14±0.36**a**
Social Interaction (SI)						
Morning	1.84±0.27**ab**	2.41±0.41a	1.24±0.15**b**	1.33±0.49	0.51±0.14	0.62±0.15
Afternoon	2.92±0.46	2.44±0.36	2.24±0.21	1.39±0.52	0.42±0.13	1.05±0.28
Night	0.22±0.06**b**	0.59±0.14**a**	0.27±0.07**b**	0.19±0.08	0.03±0.01	0.11±0.03
Fighting (FGH)						
Morning	1.22±0.22	1.04±0.15	0.79±0.12	0.01±0.01	0.03±0.02	0.16±0.10
Afternoon	1.06±0.18	1.07±0.16	0.87±0.14	0.00±0.00	0.06±0.04	0.15±0.09
Night	0.10±0.03**b**	0.16±0.03**a**	0.15±0.04**a**	0.00±0.00	0.00±0.00	0.02±0.02
Lying agglomerated (LAG)						
Morning	49.49±2.13**b**	58.09±2.01**a**	64.93±1.94**a**	46.20±2.64**b**	61.13±6.85**a**	46.18±2.21**b**
Afternoon	39.03±2.40	49.52±2.45	43.93±2.20	23.36±2.72**b**	49.66±9.02**a**	27.51±2.24**b**
Night	91.89±1.48	90.87±0.52	91.09±0.97	83.45±1.81**b**	92.22±2.60**a**	85.61±1.45**b**
Lying alone (LA)						
Morning	9.38±1.49	6.54±0.56	4.22±0.51	22.48±2.29	17.72±3.25	22,82±2,99
Afternoon	12.42±1.62	9.15±1.08	8.49±1.16	35.74±2.57**a**	24.71±4.58**b**	34,55±4,07**a**
Night	2.13±0.53	1.76±0.20	1.66±0.22	9.75±1.45**a**	4.50±1.69**b**	7,345±1,28**a**
Sitting (SIT)						
Morning	0.22±0.04**b**	0.48±0.13**a**	0.04±0.01**b**	0.31±0.08	0.22±0.06	0,313±0,064
Afternoon	0.30±0.04**ab**	0.49±0.08**a**	0.17±0.06**b**	0.35±0.08	0.25±0.08	0,412±0,080
Night	0.04±0.02**b**	0.08±0.02**a**	0.03±0.01**b**	0.04±0.01	0.02±0.01	0,030±0,011

Mean values followed by the same letter in the rows, within each season, are not different by t-test (P<0.05)

The behaviors DW, SI and SIT were similar, with significant differences (p<0.05) only in the winter, where the lighting program 23L:1D presented higher percentage values of behavior than the other programs.

In general, the behavior FGH did not present significant difference between the lighting programs, except for the night shift during the winter, for the programs 23L:1D and 16L:8D.

Statistical differences (p<0.05) were found for the behavior LAG during the summer in all the shifts, in which the program 23L:1D had greater percentages compared with the other programs (Table 3). In the winter, differences were observed only in the morning shift, with the programs 23L:1D and 16L:8D presenting the highest percentages (p<0.05) in relation to the lighting program NL.

Regarding the behavior LA, significant differences (p<0.05) were registered only during the summer, for the afternoon and night shifts, when the program 23L:1D had the lowest percentages.

For a better visualization of the results, data were plotted into graphs as a function of the behaviors (Figure 1).

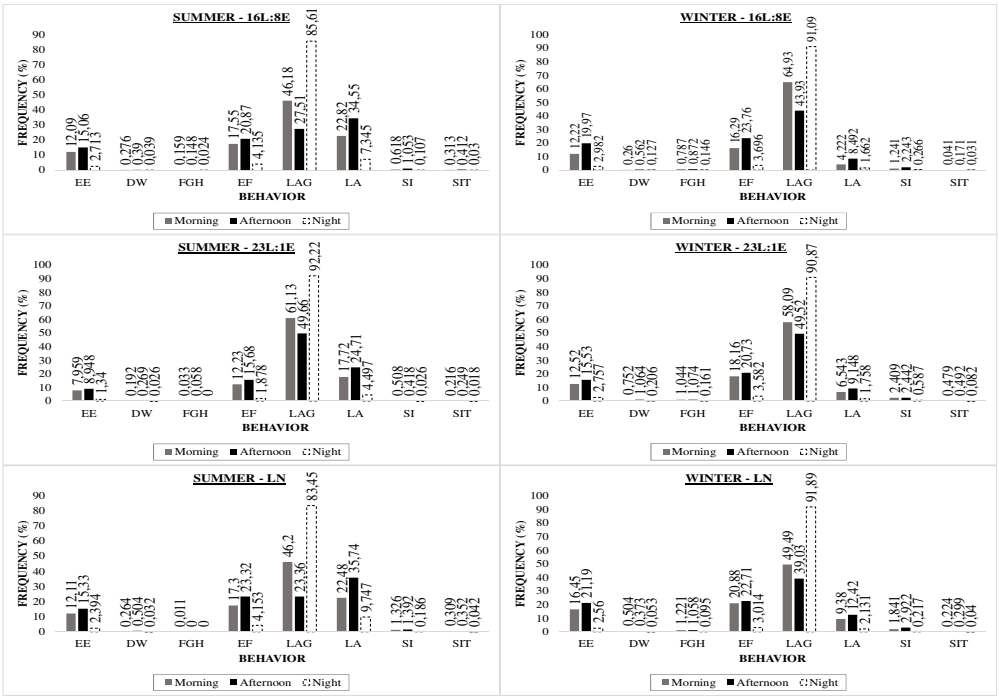

Figure 1 - *Frequency of piglets behavior.*

4 CONCLUSÃO

The piglets assessed in the different schedules of light presented distinct behaviors, but without a clear pattern during the nursery period. Since other studies have pointed out contradictory results, it is required further studies on this subject.

5 AGRADECIMENTOS

To CNPq/MAPA. Process–577860/2008-9 for financial support.

6 REFERÊNCIAS

AGUGGINI, G.; BEGHELLI V.; GIULIO L. F. **Fisiologia degli animali domestici com elementi di etologia**. Torino: UTET, 1992. 924 p.

AMARAL, A. L.; SILVEIRA, P. R. S; LIMA, G. J. M. **Boas práticas de produção de suínos**. Concórdia: Embrapa Suínos e Aves, 2006. (Embrapa Suínos e Aves. Circular técnica, 50).

BALDWIN, B. A. Operant studies on the behavior of pigs and sheep in relation to the physical environment. **Journal of Animal Science**, Champaign, v. 49, p. 1125-1134, 1979.

BROOKS, P. H. Factors affecting the voluntary feed intake of the weaned pig. In: PLUSKE J. R.; LE DIVIDICH, J.; VERSTEGEN, M. W. A. (Ed.) **Weaning the pig:** concepts and consequences. Wageningen: Wageningen Academic Publishers, 2003. p. 81-116.

BRUININX, E. M. A. M.; HEETKAMP, M. J. W.; VAN DEN BOGAART, D.; VAN DER PEET-SCHWERING, C. M. C.; BEYNEN, A. C.; EVERTS, H.; DEN HARTOG, L. A.; SCHRAMA, J. W. A prolonged photoperiod improves feed intake and energy metabolism of weanling pigs. **Journal of Animal Science**, Champaign, v. 80, n. 7, p. 1736-1745, 2002.

BRUININX, E. M. A. M.; VAN DER PEET-SCHWERING, C. M.; SCHRAMA, J. W.; VEREIJKEN, P. F.; VESSEUR, P. C.; EVERTS, H.; DEN HARTOG, D. A.; BEYNEN A. C. Individually measured feed intake characteristics and growth performance of group-housed weanling pigs: effects of sex, initial body weight, and body weight distribution within groups. **Journal of Animal Science**, Champaign, v. 79, n. 2, p. 301-308, 2001.

CAMPOS, J. A.; TINÔCO, I. DE F. F.; BAÊTA, F. C.; CECON, P. R.; MAURI, A. L. Qualidade do ar, ambiente térmico e desempenho de suínos criados em creches com dimensões diferentes. **Engenharia Agrícola**, Jaboticabal, v. 29, p. 339-347, 2009.

DAY, J. E. L.; KYRIAZAKIS, I.; LAWRENCE, A. B. An investigation into the causation of chewing behaviour in growing pigs: the role of exploration and feeding motivation. **Applied Animal Behaviour Science**, Amsterdam, v. 48, p. 47-59, 1996.

DUDINK, S.; SIMONSE, H; MARKS, I; DE JONGE, F. H.; SPRUIJT, B. M. Announcing the arrival of enrichment increases play behaviour and reduces weaning-stress-induced behaviours of piglets directly after weaning. **Applied Animal Behaviour Science**, Amsterdam, v. 101, p. 86–101, 2006.

FRASER, D. The "new perception" of animal agriculture: legless cows, featherless chickens and a need for genuine analysis**. Journal of Animal Science**, Champaign, v. 79, p. 634-641, 2001.

GUNDLACH, H. Brutfürsorge, brutpflege, erhaltensontogenese und tagesperiodik beim europä ischen wildschwein (*Sus scrofa* L.) **Zeitschrift fur Tierpsychologie**, Berlin, v. 25, p. 955–995, 1968.

GUY, J. H.; ROWLINSON, P.; CHADWICK, J. P.; ELLIS, M. Behaviour of two genotypes of growing–finishing pig in three different housing systems. **Applied Animal Behaviour Science**, Amsterdam, v. 75, p. 193–206, 2002.

MARTELLI, G.; SCALABRINI, M.; SARDI, L. The effects of the duration of the artificial photoperiod on the growth

parameters and behaviour of heavy pigs. **Veterinary Research Communications**, Midlothian, v. 29, n. 2, p. 367-369, 2005.

NIECKAMP, S. R.; SUTHERLAND, M. A.; DAHL, G. E.; SALAK-JOHNSON, J. L. Immune responses of piglets to weaning stress: impacts of photoperiod. **Journal of Animal Science**, Champaign, v. 85, n. 1, p. 93-100, 2007.

PANDORFI, H.; SILVA, I. J. O.; MOURA, D. J.; SEVEGNANI, K. B. Análise de imagem aplicada ao estudo do comportamento de leitões em abrigo escamoteador. **Engenharia Agrícola,** Jaboticabal, v. 24, n. 2, p. 274-284, ago. 2004.

PELTONIEMI O. A.; VIROLAINEN, J. V. Seasonality of reproduction in gilts and sows. **Society of Reproduction and Fertility Supplement,** Nottingham, v. 62, p. 205-218, 2006.

PORTUGAL. Ministério da Agricultura, Desenvolvimento Rural e Pescas. Decreto Lei nº 135, de 28 de junho de 2003. **Diário da República Eletrónico [de Portugal]**, Lisboa, n. 147, 28 jun. 2003. Seção 1, p. 3719-3724.

ROSTAGNO, H. S.; ALBINO, L. F. T.; DONZELE, J. L.; GOMES, P. C.; FERREIRA, A. S.; OLIVEIRA, R. F.; LOPES, D. C. **Tabelas brasileiras para aves e suínos**: composição de alimentos e exigências nutricionais. Viçosa: UFV, 2005.

SABINO, L. A.; SOUSA JUNIOR, V. R.; ABREU, P. G.; ABREU, V. M. N.; LOPES, L. S. L.; COLDEBELLA, A. Comportamento suíno influenciado por dois modelos de maternidade. **Revista Brasileira de Engenharia Agrícola e Ambiental,** Campina Grande, v. 15, n. 12, p. 1321-1327, 2011.

SAS. Statistical Analisys System. **System for Microsoft windows, release 9.1**. Cary, 2003. 1 CD-Rom.

SILVA, W. T.; MOURA, D. J.; NÄÄS, I. A.; MENDES, A. S.; LIMA, K. A. O. Estimativa de bem-estar de leitões utilizando a visão computacional. **Revista Brasileira de Agroinformática**, São Paulo, v. 6, p. 79-89, 2004.

SONDERGAARD, L. V.; JENSEN, K. H.; HEMMINGSEN, R.; HANSEN, A. K.; LIND, N. M. Characterisation of Spontaneous Behaviour in Göttingen Minipigs in the Home Pen. **Scandinavian Journal of Laboratory Animal Science**, Frederiksberg, v. 34, n. 2, 2007.

STOLBA, A.; WOOD-GUSH D, G. M. The behaviour of pigs in a semi-natural environment. **Animal Production**, Cambridge, v. 48, p. 419-425, 1989.

TAYLOR, N.; PRESCOTT, N.; PERRY, G.; PORTER, M. L. E.; SUEUR, C.; WATHES, C. Preference of growing pigs for illuminance. **Applied Animal Behaviour Science**, Amsterdam, v. 96, n. 1, p. 19-31, 2006.

ZHANG, J.; WHANG, W.; ZHANG, W.; HAI-BO, L. Activity patterns of wild boar in South Xiaoxing' an mountains. **Chinese Journal of Zoology**, Beijing, v. 42, p. 90-93, 2007.