EVALUATION OF DURATION OF TONIC IMMOBILITY IN CAPTIVE PARTRIDGES *(Rhynchotus rufescens)*

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INTRODUCTION

Breeding wild species in captivity very often fail, due to the lack of knowledge of breeding and handling techniques. The native patridge from Brazil *(Rhynchotus rufescens)* has awakened great interest in the sale of its meat. This leads to the quest for solutions to reach acceptable indices of animal husbandry. In this context animals better adapted to living in captivity can be selected, by using appropriate detection methods. Among these, the duration of tonic immobility of the birds in response to a given stress, can be used as a measure for stress. This behaviour can be described as a reversible physical immobility interrupted brusquely, reflecting different levels of fear or shyness.

MATERIAL AND METHODS

Breeding and evaluation of the time of tonic immobility. This study was conducted at the Sector for Wild Animals of the Department of Animal Husbandry of the Faculty of Agrarian and Veterinary Sciences of Universidade Estadual Paulista (UNESP), Campus of Jaboticabal. Duration of tonic immobility was measured on young birds of twenty six families settled in August 1999. Each family was composed of two females and one male, housed in wire netting boxes of approx. 8 m^2, divided into 9 sectors, located in an avian shed. The ground was covered with a hay bed of *Cynodon dactylon* (Coast cross). The rationing and supply of water was made daily *ad libitum*. No vaccines were used. The hatches occurred daily, from September 27 to March. The individuals were identified by a provisional band and subsequently, when reaching approx. 90 g of live weight, by a permanent wing-banding. The young birds were weighed weekly, and sexing was conducted in accordance with Moro (1994) when the animals reached approx. 250 g. Three separate evaluations of the duration of tonic immobility of the birds were carried out during the 6 days of the experiment, by measuring the length of time during which the birds remained motionless after having been placed on their back. Limits of 10 seconds (minimum) and one hour (maximum) of absence of motion were set.

Statistical analyses. The consistency of the data was assured by the SAS (1996) program, by using the data of 489 time measurements of tonic immobility of 189 animals. Twenty contemporary groups composed by sector, day and period were formed. The weekly age classes were joined from the 1st to the 6th and 29th to the 31st week, resulting in a total of 24 classes. The time of tonic immobility was evaluated according to the method of Least-Squares, by adopting the procedure GLM (SAS, 1996), according to the statistical model as described below:

$Y_{ijklmn} = \mu + s_i + s_{ij} + CG_k + I_{lm} + L_n + e_{ijklmn}$,where

Y_{ijklmn} = Time of tonic immobility, in seconds;
μ = general mean;
s_i = random effect of the i^{th} sire;
s_{ij} = random effect of the j^{th} repetition within the i^{th} sire;
CG_k = fixed effect of the k^{th} contemporary group;
I_{lm} = fixed effect of the l^{th} order of measurement within the m^{th} sector;
L_n = fixed effect of the n^{th} age, in weeks;
e_{ijklmn} = random error.
The fixed effects of the model were contemporary group, order within sector and age, in weeks. The order of measurement within the sector was used as a covariable. Sire and animal within sire were considered random effects. The estimates of variance components of the time of tonic immobility were provided by an animal model using the method of Derivative-free Restricted maximum likelihood, performed by MTDFREML program (Multiple Trait Derivative-Free Restricted Maximum Likelihood), developped by Boldman *et al.* (1993). The estimates of heritability and repeatability were obtained in accordance with the equations:
$h^2 = \sigma^2_a / \sigma^2_a + \sigma^2_{ep} + \sigma^2_e$; $t = \sigma^2_a + \sigma^2_{ep} / \sigma^2_a + \sigma^2_{ep} + \sigma^2_e$,where
h^2 = estimate of heritability of trait;
t = estimate of repeatability of trait
σ^2_a = estimate of additive genetic variance;
σ^2_{ep} = estimate of permanent environmental variance;
σ^2_e = estimate of residual variance.
For this model,the following assumptions were made:
$E(Y) = X\beta$; $E(a) = 0$; $E(ep) = 0$; $E(e) = 0$; $Cov(a,p) = 0$; $Var(a) = A\sigma^2_a$;
$Var(p) = I_{NP}\sigma^2_{ap}$; $Var(e) = I_N\sigma^2_e$, in which
A = number of animals of kinship matrix, I = Identity matrix,
NP = Number of partridges and N = Number of records.

RESULTS AND DISCUSSION

The average value of the duration of tonic immobility was 311 seconds, with a standard deviation of 394 seconds, with observations ranging from 10 to 3600 seconds. A great variation among animals can be noted. The values obtained in this analysis were higher than those observed in turkeys by Noble *et al.* (1996), with at most 60 seconds duration, and in hens (Bilcik *et al.*, 1998) varying from 46.8 s to 600 s, according to number of birds in the box. For cockerels of 40 days, an average of 327.9±52.1 seconds of tonic immobility after exposure to a stress factor was observed, as compared to an average of 181.0±42.7 seconds for animals not exposed to stress (Marin *et al.*, 2001). Table 1 shows the summary of the analysis of variance of the time of tonic immobility.

The random effects of sire, animal within sire and effect of the contemporary group were found significant. The average values observed were lower for the contemporaneous groups whose boxes were located in such a way as to afford less contact with people and admit less noise. The age of the animals did not denote a definite tendency; however, a progressive increase in the duration of tonic immobility up to the 16^{th} week can be noted, after which a slight drop in average values occurs; these assume a quadratic tendency, suggesting that the older animals may be about to become accustomed to the weekly weighing routine.

Table 1. Summary of the analysis of variance of the time of tonic immobility

Sources of variation	DF	MS	F	
Sire	25	349246.5	2.57 **	$R^2 = 0.30$
Animal within sire	26	276628.9	2.03**	C.V. = 118.6
CG	19	221198.0	1.62*	
Age	23	146855.4	1.08 ^{NS}	
Order within sector	5	133256.3	0.98 ^{NS}	
Error	251	136147.89		

DF= degree of freedom ; MS= mean square; CG= contemporary group.

According to Heiblum *et al.* (1998) who analyzed the duration of tonic immobility during the first week of life of chicks, it is only as of the 5th day that this effect is found consistently. Brake *et al.* (1994) observed differences between animals of 15 and 20 weeks of age. They found that the duration of tonic immobility was shorter for the younger animals, justified by the likely action of sexual hormones which are present at the beginning of the sexual maturity. Table 2 shows variance components estimates.

Table 2. Variance components estimates for tonic immobility

Variance components		
$\sigma^2_a = 49910.8$	$\sigma^2_{ep} = 0.092$	$\sigma^2_e = 117708.3$

σ^2_a = estimate of additive genetic variance; σ^2_{ep} = estimate of permanent environmental
σ^2_e = estimate of residual variance.

The estimates of heritability and repeatability obtained were 0.30. Similar heritability values were estimated by Craig and Muir (1989) in hens (0.28), and Gerken and Petersen (1992) in Japanese quail (0.26). The heritability coefficient obtained suggests the presence of an additive genetic action, and changes in the average values coud be obtained using selection, as shown by Mills and Faure (1991). The tonic immobility is a behavioral measurement, quite strongly subject to the action of the temporary environment, which enhances the importance of management when raising this species in captivity. In addition, it shows negative genetic correlations with production indices such as growth, feed conversion, egg production and product quality (Jones, 1996), resulting in the possibility of including tonic immobility as a criterion in the animal evaluation and selection process.

CONCLUSION

Additive genetic differences exist among animals in respect to the trait duration of tonic immobility. More than one measurement of the trait must be taken in order to take culling decisions based on this trait.

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