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Sexual behavior and seminal characteristics of fertile mature New Zealand White male rabbits of different body weights

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ABSTRACT

Body weight in different mammalian species influences reproductive potential. The aim of the present study was to determine the relationship of body weight at the time of semen collection with libido, seminal characteristics and number of semen doses for artificial insemination (AI) in New Zealand White mature fertile male rabbits. Data came from 728 semen collections of 14 rabbits, 15-months of age that were sexually experienced with proven semen quality and fertility. Semen collection was performed twice a week with two ejaculates at each collection time and lasted 14 weeks. A second ejaculation was collected at 1–2 h after the first. Data from each male from first and second ejaculates from 1 day of semen collection throughout the trial were averaged ($n = 324$) and partial correlation coefficients and regression equations were estimated to describe the relationship of male body weight to ejaculation reaction time and 12 semen and sperm characteristics. As body weight increased there was a linear ($P < 0.05$) increase in reaction time, abnormal sperm with an intact membrane and abnormal sperm with a damaged membrane and a linear ($P < 0.05$) decrease in semen volume, sperm concentration per ejaculate, normal sperm with an intact membrane, number of normal motile sperm with an intact membrane and suitable semen doses for AI. Body weight of the mature male rabbit at semen collection had some influence on libido, semen and sperm characteristics, with a general trend toward a lesser reproduction potential as body weight increases.

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1. Introduction

The success of an artificial insemination (AI) program in rabbits depends greatly on the health and reproductive performance of males at the time of semen collection; lack of seasonal impacts on libido, large volume sperm production, motility and viability of sperm and few sperm abnormalities. Sexual behavior, sperm production and quality vary with genotype, age, season, rearing conditions, reproductive rhythm, nutrition, social environment, health status and body weight (Alvariño, 2000; Castellini, 2008; Rodríguez-De Lara et al., 2010).

Nevertheless, the microscopic measurement of sperm quantity and quality is time consuming and currently there is no simple and rapid method to evaluate semen at a minimal cost. Thus, simple and reliable indirect methods for *in vivo* estimation of seminal characteristics based on correlations between important traits and variables are

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needed. Among different farm animals body weight is related to sexual behavior and sperm production and quality. Cameron (1985) found highly positive correlations of body weight and many seminal characteristics in boars. In chickens, body weight was positively correlated with semen volume, pH and abnormal sperm, and negatively correlated with sperm motility, sperm concentration and number of live sperm (Ramamurthy et al., 1989). Body weight influences on seminal characteristics have been reported in cockerels (Galal, 2007; Bratte et al., 2011), goats (Webb et al., 2004; Kabiraj et al., 2011), bulls (Sarder, 2008) and boars (Fuentes et al., 1989; Ugwu et al., 2009).

Early studies in rabbits provided evidence that sperm production was influenced by body weight (Hafez, 1970). Brun et al. (2006) found that males that weighed less from one of two lines divergently selected for body weight had greater semen volume, sperm motility and number of sperm per ejaculate that were suitable for AI than those of the line with greater weights. However, there is little information available on the effect of body weight at the time of semen collection on reproduction potential of commercial mature male rabbits managed in an AI program. A strategy to optimize reproductive performance of male rabbits is to ascertain an optimal body weight. It is, therefore, hypothesized in the present study that sexual behavior and semen quality characteristics are related to body weight at the time of semen collection in rabbits. The objective of the study was to determine the relationship of body weight with libido, seminal characteristics and number of suitable semen doses for AI in mature fertile New Zealand White male rabbits under a semi-intensive AI program.

2. Materials and methods

2.1. Source of data

Data came from a trial conducted at the Rabbit Research Station "Conejos" of the Centro de Investigación Científica del Estado de México A.C., located in the Valley of Mexico at 19°27′ N, 98°5′ W, 2240 m above sea level and a mean annual temperature of 15 °C. Detailed information of the trial is published elsewhere (Rodríguez-De Lara et al., 2010).

The data used in this study came from 728 semen collections of 14 New Zealand White male rabbits 15-months of age that were sexually experienced and had proven semen quality and fertility. Rabbits were kept individually in cages in a flat-deck system, with natural ventilation and a daily light regimen of 8/16 h (light/dark). Rabbits were fed a commercial pelleted diet (16.7% crude protein, 3.8% fat, 16.7% crude fiber and 2313 kcal of digestible energy per kg) that was offered at 120 g per day for each male. Semen was collected twice weekly with two ejaculates at each collection time and the period of semen collection lasted 14 weeks. The second ejaculate was obtained at 1–2 h after the first.

2.2. Semen collection procedure and measured variables

Male body weight was measured prior to semen collection with a digital scale. Semen was collected with an English type artificial vagina following the procedures of Rodríguez-De Lara et al. (2003). Semen from each ejaculation was kept in a 31 °C water-bath for further handling and evaluation. Reaction time was the time interval from the introduction of the "teaser" doe into the male's cage to ejaculation and was considered an indication of libido. Seminal characteristics evaluated were the proportion of ejaculates with the presence of the gel fraction, volume and pH. Gamete characteristics evaluated were motility, concentration per milliliter and per ejaculate, normal sperm with an intact membrane, abnormal sperm with an intact membrane, normal sperm with a damaged membrane, abnormal sperm with a damaged membrane and number of normal motile sperm with an intact membrane per ejaculate and the number of suitable semen doses for AI.

The gel-free semen volume was measured directly on the transparent graduated collector tube at 0.2 mL intervals. The presence of the gel fraction was registered as positive if in at least one of the ejaculates gel was present. Semen pH was determined immediately after collection using a pH paper ranging from 7 to 12 with 1 grade (Dual-Tint). Sperm motility was assessed subjectively from 0% to 100% based on a defined score criteria using a Labomed CxL binocular light microscope (Lab. America, Inc.) at 100× magnification. Sperm per milliliter were determined by an improved bright-line haemocytometer (Marienfeld, Germany) and per ejaculate by multiplying ejaculate volume and sperm concentration per milliliter. Sperm membrane integrity and morphology characteristics were measured after staining with eosin/negrosin and counting 200 sperm at 100× under oil immersion. Sperm were identified as membrane intact or membrane damaged and classified as either normal or abnormal (head, midpiece and tail defects). The normal motile sperm with an intact membrane per ejaculate was obtained by multiplying the number of sperm per milliliter and volume as well as motility and percentage of normal sperm with an intact membrane. The number of suitable semen doses for AI was calculated as the ratio of normal motile sperm with an intact membrane in the ejaculate divided by 5 million.

2.3. Statistical analysis

Data from each male from first and second ejaculate at each semen collection time throughout the study were averaged ($n = 364$) and correlation coefficients and regression equations were calculated to describe the relationship of male body weight with reaction time, seminal characteristics and number of semen doses suitable for AI. Linear, quadratic and cubic regression equations were fitted to the data. Pearson correlation coefficients and regression equations were calculated by PROC CORR and PROC REG procedures of SAS (2011), respectively. Graphs were plotted. Only those relationships which were significant ($P < 0.05$) are presented in the results.

3. Results

The descriptive statistics and coefficient of variation of body weight, semen and sperm characteristics are included in Table 1. Mean and standard deviation of male body weight at the time of semen collection was 3620 ± 246 g

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