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MORPHOMETRIC CHARACTERISTICS OF DWARF RABBITS: EFFECTS OF AGE AND GENDER

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ABSTRACT

The aim of the study was to provide information on the morphometric development of dwarf rabbits from growing until adult age, according to their gender. A total of 136 "coloured dwarf" rabbits (74 males and 62 females) were used. At 20 and 45 weeks of age, the rabbits were weighed and body measurements were taken on each rabbit at predefined anatomical points using a digital Caliper (mm) or a measuring tape (cm). The measurements included: three distance measurements (in cm): body length, BL; ear length, EL; head length, HL; height measurement (in cm): head height, HH; seven width measurements: shoulder width, SW and rump width, RW (in cm); tibia width, TW and ear width, EW (in mm); forehead width, FHW and head width, HW (in cm), skin fold width, FW (in mm); two circumferences (in cm): thoracic circumference, TC; and abdominal circumference, AC. Using these body measurements, a total of 3 body indices were estimated to define the general conformation of the animals: compact index 1: rump width/body length (RW/BL); compact index 2: thoracic circumference/body length (TC/BL); compact index 3: abdomen circumference/body length (AC/BL). Data collected were subjected to analysis of variance (ANOVA) studying the effect of age (20 wk, 45 wk), sex (M, F), and their interaction (age x sex). Statistical significance of differences was assessed by the t-test. Considering the main effects, all traits were affected by age and almost all body measurements by sex with the exception of BL, EL, FHW, HL, and TC/BL. At both ages, females showed heavier live weights than males (1,630 *vs* 1,542 g and 1,953 *vs* 1,850 g, at 20 and 45 wk of age, respectively). Significant sex differences were also found for AC at 45 wk of age: females presented higher AC value than males (29.5 *vs* 27.8 cm; $P<0.01$). Concerning head measurements with increasing age, males showed the highest mean value of FHW and HW than females at 45 and at 20 wk (4.25 *vs* 4.13 and 3.86 *vs* 3.87 cm, $P<0.05$; 4.64 *vs* 4.29 and 4.34 *vs* 4.18 cm, $P<0.01$, respectively). The FW results showed significantly higher values for males at 45 and 20 wk of age than females (4.28 *vs* 3.63 and 3.76 *vs* 3.62 mm, $P<0.01$, respectively). With regards to the indices, only the compact index 1 (RW/BL) showed significant differences ($P<0.01$) with males at 20 wk being less compact than females. The results showed clear sexual dimorphism for nearly all traits considered, resulting in heavier live weights in females than males at both ages. Considering that some body measurements did not correspond to the breed standards for "coloured dwarf" rabbits and that they showed a high degree of variability, this suggests that through the selection process that other breeds were used in its formation. The use of uncontrolled selection at the commercial scale could lead to this breed becoming in danger of extinction.

Key words: Dwarf rabbit, Morphometric measurements, Age, Gender.

INTRODUCTION

The interest in obtaining dwarf rabbits to produce pet animals has led to the development of many new breeds, sometimes derived from indiscriminate crossbreeding and characterized by animals that show different phenotypes. In the mission of breed conservation, genetic characterization is the first step to assess the phenotypic characteristics, and for this reason the maintenance of breed integrity is a prerequisite for managing genetic resources. The combination of information derived from the study of morphometric traits and genetic characteristics provides important baseline data for future breed conservation (Gomez *et al.*, 2011; Jordana *et al.*, 2010). The growth of animals involves an increase in body weight, which can change the conformation of various parts of the body. Also, the sex can affect phenotypic aspects. For this reason, it is important to study the effect of these two factors on morphometric development (Shahin and Hassan, 2002). The aim of this study was to provide information on the relationships among body measurements with age and gender in dwarf rabbits.

MATERIALS AND METHODS

Animals and housing

The trial was approved by the Italian Ministry of Education, University and Research, and all animals were treated humanely according to the principles stated by the EC Directive 86/609/EEC regarding the protection of animals used for experimental and other scientific purposes. The study was carried out at the experimental rabbitry of the University of Padova (Italy). The animals were housed individually in fattening cages (240 x 400 x 280 mm) from 5 to 21 weeks of age, and in pens (620 x 500 mm) from 21 to 45 weeks of age. The cages were made of galvanized wire net, whereas pens were provided with plastic slats, and both pens were equipped with feeders and automatic drinkers. A total of 136 “coloured dwarf” (nomenclature of Fédération Française de Cuniculiculture) rabbits (74 males and 62 females) of 5 weeks of age were purchased from a commercial breeder, sexed and housed individually, under controlled environmental conditions.

Body measurements and indices

At 20 and 45 weeks of age, the rabbits were weighed and body measurements were taken at predefined anatomical points using digital a Caliper (0-150 mm – Juwel) and a measuring tape (cm). For the measurement procedures, the rabbits were put on a table and the same person measured the animals during the experiment. If the measuring process was disturbed, it was repeated. To evaluate the repeatability of measurements, all individuals were measured twice and the mean was used for the statistical analysis.

The measurements were:
- 3 distance measurements (in cm): body length, BL, was measured from atlas to the first coccygeal vertebra; ear length, EL, was taken from the bottom to the top of the ear; head length, HL, was measured from the knob of the occipital to the top of the nose;
- 1 height measurement (in cm): head height, HH, was taken from forehead to the mandible;
- 4 width measurements (in cm): shoulder width, SW, was measured between the outermost points of shoulder blades; rump width, RW, was measured between the outermost points of thighs; forehead width, FHW, corresponds to the distance between two points above the orbital cavities; head width, HW, corresponds to the distance between the external corners (angles) of the orbital cavities;
- 3 width measurements (in mm): tibia width, TW, was taken at the midpoint of the right tibia, ear width, EW, was taken at the distance of 2 cm from the top of the ear; skin fold width, FW, was measured at the level of the back;
- 2 circumferences (in cm): thoracic circumference, TC, was measured behind the shoulder blades; abdominal circumference, AC, was taken at the level of the 7^{th} lumbar vertebra.

- Using these body measurements, a total of 3 body indices were estimated to define the general conformation of the animals: compact index 1: rump width/body length (RW/BL); compact index 2: thoracic circumference/body length (TC/BL); compact index 3: abdominal circumference/body length (AC/BL).

During the trial, morbidity and mortality was recorded twice a week. Twelve males and seven females showed health problems after 20 weeks, and their records were excluded from growth and body measurement data.

Statistical analysis

Data collected were subjected to analysis of variance (ANOVA) using age (20 and 45 wk), sex (M and F) and their interaction (age x sex) as main effects. Statistical significance of differences was assessed by the Student's t-test (SAS, 2002).

RESULTS AND DISCUSSION

The effects of age and gender on live weights and body measurements are presented in Table 1. Considering the main effects, all traits were, as expected, affected by age and almost all body measurements by gender. Independently by the sex, with increasing age, body weight increases and body composition varies. These processes are accompanied by concomitant changes in the phenotype (Ouhayoun, 1998; Dalle Zotte, 2002; Shahin and Hassan, 2002). Regarding the gender effect, almost all the traits were affected with the exception of BL, EL, FHW, HL, TC/BL. At both ages, females showed heavier live weights than males (1,630 *vs* 1,542 g and 1,953 *vs* 1,850 g, at 20 and 45 wk of age, respectively). Significant sex differences were found for AC at 45wk of age: females presented a higher AC value than males (29.5 *vs* 27.8 cm; P<0.01). Concerning head measurements, as age increased, males showed the highest mean value for FHW and HW than females at 45 and 20 wk (4.25 *vs* 4.13 and 3.86 and 3.87 cm, P<0.05; 4.64 *vs* 4.29 and 4.34 *vs* 4.18 cm, P<0.01, respectively). The FW results were significantly higher in males at 45 and 20 wk of age than females (4.28 *vs* 3.63 and 3.76 *vs* 3.62 mm, P<0.01, respectively). With regards to the indices, only the compact index 1 (RW/BL) showed significant differences (P<0.01) with males at 20 wk being less compact than females.

Table 1: Effect of age and sex on body measurements of dwarf rabbit

Age (A)		20 wk	20 wk	45 wk	45 wk	*P*-value			RSD
Sex (S)		M	F	M	F	Age (A)	Sex (S)	Interaction AxS	
No. of rabbits		74	62	62	55				
Live weight	g	1,542	1,630	1,850	1,953	<0.001	<0.001	0.79	231
Shoulder width (SW)	cm	5.76	5.99	6.58	6.84	<0.001	<0.001	0.83	0.54
Rump width (RW)	cm	8.29	8.84	9.00	9.25	<0.001	<0.001	0.07	0.68
Body length (BL)	cm	30.0	29.9	30.6	31.0	<0.001	0.45	0.37	1.87
Thorax circumference (TC)	cm	24.1	24.8	25,8	26.3	<0.001	<0.01	0.60	1.59
Abdominal circumference (AC)	cm	26.0^{C}	26.2^{C}	27.8^{B}	29.5^{A}	<0.001	<0.001	<0.01	2.19
Tibia width (TW)	mm	7.58	7.22	8.30	8.06	<0.001	<0.01	0.55	0.87
Ear length (EL)	cm	7.75	7.65	8.22	8.10	<0.001	0.14	0.94	0.58
Ear width (EW)	mm	1.46	1.34	1.12	0.98	<0.001	<0.05	0.86	0.46
Forehead width (FHW)	cm	3.86^{c}	3.87^{c}	4.25^{a}	4.13^{b}	<0.001	0.06	<0.05	0.25
Head length (HL)	cm	12.2	12.0	10.9	10.8	<0.001	0.11	0.85	0.79
Head width (HW)	cm	4.34^{B}	4.18^{C}	4.64^{A}	$4.29B^{C}$	<0.001	<0.001	<0.01	0.25
Head height (HH)	cm	4.82	4.76	4.98	4.88	<0.001	<0.01	0.55	0.23
Skin fold width (FW)	mm	3.76^{B}	3.62^{B}	4.28^{A}	3.63^{B}	<0.01	<0.001	<0.01	0.69
Compact index 1 (RW/BL)		27.8^{b}	29.7^{a}	29.5^{a}	29.9^{a}	<0.01	<0.001	<0.05	2.54
Compact index 2 (TC/BL)		81.0	83.2	84.6	85.0	<0.001	0.10	0.25	6.30
Compact index 3 (AC/BL)		87.1	88.1	90.9	95.3	<0.001	<0.01	0.08	7.62

Means with different letters in the same row differ significantly (P<0.05).

From a morphological point of view, based on this data set, body measurements reflected the influence of genetic selection used to produce dwarf rabbits, which yields useful information about the investigated breed. At maturity, the population showed clear sexual dimorphism with live weights and ear lengths exceeding values considered standard for the "coloured dwarf" breed (standards of 1,200-1,500 g as maximum live weight and 7 cm as maximum ear length).

CONCLUSIONS

Considering that some body measurements did not correspond to the breed standards for “coloured dwarf” rabbits and that they showed a high degree of variability, this suggests that through the selection process that other breeds were used in its formation. The use of uncontrolled selection at the commercial scale could lead to this breed becoming in danger of extinction.

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