Global Veterinaria 13 (6): 1051-1055, 2014
ISSN 1992-6197

DOI: 10.5829/idosi.gv.2014.13.06.86249

Growth Traits and Body Dimensions of Growing Male Rabbit as Affected by Breed and Dose of Boldenone Undecylenate

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Abstract: The present study was based to investigate the effect of boldenone undecylenate (BUL) on growth traits and body dimensions of 135 growing male rabbits of three breeds which were: 45 New Zealand White (NWZ), 45 Californian (CAL) and 45 Rex (RX), randomly assigned to a completely randomized design with a 3 x 3 factorial arrangement of treatments (three breeds: NWZ, CAL and RX; and three doses: control (0.25 ml sesame oil/kg bw), normal dose of boldenone undecylenate (4.4 mg/kg bw) and double dose (8.8 mg/kg bw) and 15 replicates. Rabbits injected intramuscular at the 40th and repeated at the 47th day of age. Male rabbit injected with normal dose showed superiority in all growth traits compared with control and those injected with double dose. The effect of dose x breed interactions on body weight was highly significant at the 58th day of age. Breed effects on all body dimensions were significant ($P < 0.05$) with exception of ear length (EL), while dose effect was significant only on chest circumference (CHC), abdominal circumference (ABC) and thigh circumference (THC) where BUL improve these traits especially normal recommended dose. Breed x dose interactions were non-significant ($P > 0.05$) on all body dimensions with exception of body length (BL). In conclusion, BUL improve body weights, growth rates, body gains and body dimensions especially CHC, ABC and THC of male rabbit when injected at the normal recommended dose of male rabbit. Breed effects were evidenced on growth traits and body dimensions.

Key words: Rabbit · Boldenone Undecylenate · Growth Rate · Body Dimensions

INTRODUCTION

Use of rabbits as a food and income resource in developing countries continues to increase, with expanding interest in Eastern Europe and in Africa, Asia and Latin America. The ability of rabbits to reproduce and yield high quality meat on low quality diets based on forages and agricultural by-products, as well as their modest housing requirements, makes them well suited for subsistence agriculture [1].

Carcass and body measurements can vary among strains [2], rearing systems [3], slaughter ages [4] but not due to the sex [2,4]. Body measurements have been used in large animals to compare variations in size and shape and to estimate carcass [5] or body weight [6]. According to Luzi *et al*. [4], body length, chest and thigh circumference were higher and the abdominal circumference was lower in rabbits slaughtered at 120 days of age comparing to those slaughtered at 90 days.

Anabolic and androgenic agents have developed, for veterinary use, to treat physiopathological problems, as well as those of the catabolic type. These agents are closely related to sexual hormones, they have different properties and their use may produce trending toward remarkable androgenic activities. BUL, a modern anabolic, is a long-lasting, injectable agent that provides immediate effects, with low androgenic effects, has no antigonadotrophic properties. It retains nitrogen (a proteinaceous anabolic), calcium, sodium, potassium, chlorides, phosphates, producing weight gain and a great bone development, it increase protein production at muscular level. It favours actin and myosin production, specially increasing fast-contraction fiber percentage.

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There is no sufficient work on the use of BUL in rabbit to confirm its use in these animals [7] who concluded that significant improvement of total weight gain; feed efficiency and feed conversion ratio were attained after injection of BUL in male rabbit. So this present study was constructed to investigate the effect of dose of BUL on growth traits and body dimensions of male rabbit of different breeds.

MATERIALS AND METHODS

The present study was performed at experimental unit belonging to Animal Wealth Development Department, Faculty of Veterinary Medicine, Zagazig University, Egypt during the period from January to May 2014. Experimental procedures were conducted in accordance with the Zagazig University Animal Ethics Committee guidelines.

Experimental Animals and Housing: Experimental animals were obtained from San-El-Hagar Agricultural company farm, Sharkiya Governorate, Egypt. 10 does and 3 bucks from each breed (New Zealand White, Californian and Rex) were used as a foundation flock to produce the fryer rabbits upon which the experiment takes place. Bucks and does were healthy free from any disease and vaccinated against viral hemorrhagic disease and pasteurellosis and about 6 months of age and gave about two weeks before breeding for accommodation then subjected to natural mating. Breeding animals were kept individually in triangular galvanized wire Cages (40 x 60 x 50 cm) provided with nipple system for watering and manual feeder. Metal nest box (40 x 40 x 40 cm) was attached to the doe's cage. Mating was done on a purebred basis (New Zealand White females were serviced by New Zealand White male) and the same for Californian and Rex. Date of service was recorded and about 14 days of service abdominal palpation was done to determine pregnancy and for positive does nest boxes were applied on 27^{th} to 28^{th} day of pregnancy to the cage for kindling which were clean and disinfected and lined by some rice straw. Does were taken to buck cage about 10 days of kindling. Litters were weaned at 30 days of age and ear tagged, sexed and separated in fattening cages (40 x 50 x 50 cm) provided with nipple system for watering and manual trough feeder. They were raised identically under the same managerial and nutritional conditions. 14 hours lighting was provided through the experimental period. Animals were fed a commercial diet with the following characteristics: 17.5% crude protein, 14-16% crude fibers and 2300-2500 kcal / kg diet digestible energy. Both, commercial diet and water were given *ad libitum*. Daily hygienic disposal of manure accompanied by good ventilation and temperature ranged from 18-25°C inside the house with 50-60% relative humidity.

Traits Measurements: Traits measured were; body weights: fryer rabbits were weighed at 44, 58 and 72 (slaughter weight) days of age and weights were recorded in grams. Body weight gain: calculated as differences between two successive different weights. Average daily gains: calculated as the differences between two successive different weights at two different periods divided by number of days between the two weights. Body dimensions: were measured at 60 days of age and recorded in centimeters as the following: BL: the diagonal distance from the point of the shoulder to the pin bone; CHC: circumference of the thoracic cavity just behind the forelimbs; ABC: circumference of the abdominal cavity in the middle of body; THC: the circumference of the thigh muscles; EL: the distance from the base of the ear to its tip and ear width (EW): the distance across the middle of the ear, according to the procedures of [8] using a plastic tape. Measurements were taken by a single person at early morning before feed distribution.

Boldenone Undecylenate Injection: Forty five males of each breed were divided into three groups; D0 or control group, they were injected with 0.25 ml sesame oil / kg bw. D1 or normal recommended dose group, they were injected with 4.4 mg/kg bw BUL 5% oily solution (Equi-gan®; Lab Tornel, Co., Mexico), D2 or double dose group, they were injected with 8.8 mg/kg bw. The doses of BUL were calculated according to [9]. All rabbits were injected intramuscular at the 40^{th} day of age and repeated at the 47^{th} day of age.

Statistical Analysis: GLM procedures of [10] were used to determine the effects of dose of BUL and breed on growth and body dimensions using following model.

$$Y_{ijk} = U + D_i + B_j + (DB)_{ij} + E_{ijk}$$

Where: Y_{ijk}: An observation of each trait. U: The overall mean. D_i: effect of BUL dose (i = D0, D1 and D2). B_j: effect of breed (j = 1, 2 and 3, i.e. NWZ, CAL and RX). $(DB)_{ij}$: effect due to interaction between breed and dose of BUL. E_{ijk}: random deviation due to unexplained source. Differences among means were compared statistically using Duncan's multiple range tests [11].

RESULTS AND DISCUSSION

Growth Traits: The effect of different injection doses of BUL on growth traits of NZW, CAL and RX weaned male rabbits were presented in Table 1. Highly significant effect ($P < 0.001$) was detected for BUL dose on body weight at the 58th and the 72nd days of age, body weight gain from the 44th to the 72nd day of age and average daily gain at the same period ($P < 0.016$). However, the effect was significant ($P < 0.024$) on body weight gain from the 44th to the 58th day of age and average daily gain at the same period. Indeed, male rabbit injected with normal recommended dose (4.4 mg / kg bw) showed superiority in all growth traits when compared with control and those injected with double the recommended dose (8.8 mg / kg bw). It is worthy mentioned that, normal recommended dose improved growth traits of male rabbit which was reflected by significant higher total body weight gains (704 ± 20.11 g) and average daily gain (25.17 ± 0.71 g / d) when compared with their control (644±20.79 g and 23.01±0.74 g/d) and those injected with double dose (629 ± 21.00 g and 22.48 ± 0.75 g / d). Improvement of growth rate of rabbits has a great impact on body weight at the end of fattening period which is very important to producers whose income depends on kilograms of live rabbit marketed [12]. The effect of dose x breed interactions was highly significant on body weight at the 58th day of age ($P < 0.016$).

The present results indicated that BUL enhanced growth and body gain when injected at the recommended dose which could be attributable to enhancement of protein synthesis and inhibiting protein degradation through stimulation of receptors molecule in muscle cells, thus activate specific gene to produce protein as well as its effect on the activation rate of enzyme system involved in protein biosynthesis [13]. Anabolic steroids worked also by increasing insulin like growth factor one (IGF1) levels which might be at least partially leads to increasing number of satellite cells, myofiber nuclei, hypertrophy and muscle growth in treated animals and humans [14,15]. Also, erythropoiesis could be stimulated by anabolic steroids through a mechanism that may occur by stimulating erythropoietic-stimulating factor [16].

The present results were in agreement with those of Tousson *et al.* [7]. They reported that significant improvement ($P \leq 0.05$) in total weight gain; feed efficiency and feed conversion ratio were observed in male NZW rabbit injected with BUL, but they detected that double dose showed more improvement in growth traits than control and the recommended dose which disagreed with the present study. This might be explained by difference in age of males as they worked on mature males. Harmonios results were reported by Tousson *et al.* [17] who concluded that BUL injection increase significantly body weight in immature rabbits. Symeon *et al.* [18] reinforced the present results. They recorded that caponization has a depressive effect on body weights at 4, 9 and 10 weeks of age as compared with intact males which indicated the important anabolic effect of sex hormones. Contrasted results were recorded by Oda and El-Ashmawy [19] and Khalil *et al.* [20] who found that BUL injection has non-significant effect on body weights and weight gains in mature male NZW.

Body Dimensions: Body dimensions of growing male rabbit as affected by breed and dose of BUL were summarized in Table 2. Breed effects on all body dimensions traits were significant ($P < 0.05$) with exception of EL. However, dose effect was significant only on CHC, ABC and THC where BUL improves these traits especially normal recommended dose (24.05 ± 0.28, 26.97 ± 0.36 and 15.30 ± 0.25 cm; respectively). Breed x dose interaction had non-significant ($P > 0.05$) effect on all body dimensions with exception of BL. Indeed, RX males showed superiority in all body dimensions with exception of BL where CAL males depicted the longest BL (23.03 ± 0.38 cm). It's worthy to clear that there is a positive correlation between body weight at 72 days of age and THC so normal dose depicted the highest body weight and the highest THC, the same is true for RX males which agreed with previous authors [21]. Also, this can be attributable to BUL promotes the body tissue building as a result of increased nitrogen retention, protein synthesis and animals appetite [22,23] so anabolic steroid can affect body dimensions through increasing muscle mass of body and absorption of minerals from the gut so improving bone structure and increasing frame of body. Also, indirectly via stimulation of growth hormone from the hypophysis and other growth factors from liver plus several further organs [22]. Contradicted results were recorded by Olawumi [24] who cited that there were no significant breed differences in live body weight and linear measurements at the 8th week of age between NZW and California White, the same is true at the 10th- the 30th week of age. The present results were Harmonious with those cited by Oke *et al.* [25] and Isaac *et al.* [26] and Oke *et al.* [27]. In conclusion, BUL improve body weights, growth rates, body gains and body dimensions especially CHC, ABC and THC when injected at normal recommended dose of male rabbit. Breed effects were

Table 1: Effects of BUL dose, breed and their interactions on body weights, body weight gains and average daily gains.

	BB				DD		P-value		
Variable	NZW	CAL	RX	D0	D1	D2	BB	DD	DD x BB
				Body weight (g)					
44th day	899±23.87[a]	1005±25.57[b]	1015±22.56[b]	935±24.21[a]	1011±23.42[a]	973±24.45[a]	0.00	0.08	0.05
58th day	1297±22.25[a]	1347±23.83[a]	1367±21.02[a]	1285±22.56[a]	1416±21.83[b]	1310±22.79[a]	0.07	0.00	0.01
72nd day	1607±20.60[a]	1608±22.06[a]	1683±19.46[b]	1579±20.89[a]	1716±20.20[b]	1603±21.10[a]	0.01	0.00	0.06
				Body weight gain (g)					
44th - 58th day	397±17.37[a]	341±18.61[a]	352±16.47[a]	350±17.62[a]	404±17.05[b]	336±17.88[a]	0.06	0.01	0.06
58th - 72nd day	309±14.44[b]	261±15.40[a]	315±13.647[b]	293±14.68[a]	300±14.18[a]	292±14.74[a]	0.02	0.91	0.25
44th – 72nd day	707±20.50[b]	603±21.96[a]	668±19.37[b]	644±20.79[a]	704±20.11[b]	629±21.00[a]	0.00	0.02	0.84
				Average daily gain (g/d)					
44th - 58th day	28.39±1.24[a]	24.38±1.33[a]	25.19±1.17[a]	25.02±1.26[a]	28.87±1.21[b]	24.07±1.27[a]	0.06	0.01	0.06
58th – 72nd day	22.13±1.03[b]	18.69±1.10[a]	22.53±0.97[b]	20.99±1.04[a]	21.47±1.01[a]	20.90±1.05[a]	0.02	0.91	0.25
44th – 72nd day	25.26±0.73[b]	21.54±0.78[a]	23.86±0.69[b]	23.01±0.74[a]	25.17±0.71[b]	22.48±0.75[a]	0.00	0.02	0.84

BB = breed effect; DD = dose effect; D0 = Control; D1 = Normal Dose (4.4 mg / kg bw); D2 = double Dose (8.8 mg / kg bw); NZW = New Zealand White; CAL = Californian; RX = Rex.

Means within the same row not sharing the same letter within each category (dose, breed) were significantly different (P < 0.05).

Table 2: Effects of BUL dose, breed and their interactions on body dimensions at 60 days of age.

	BB				DD		P-value		
Variable (cm)	NZW	CAL	RX	D0	D1	D2	BB	DD	DD x BB
BL (cm)	21.60±0.38[b]	23.03±0.38[a]	21.87±0.38[b]	22.84±0.38[a]	21.99±0.38[a]	21.68±0.38[a]	0.02	0.08	0.04
CHC (cm)	22.21±0.28[b]	23.62±0.28[a]	24.35±0.28[a]	23.02±0.28[b]	24.05±0.28[a]	23.11±0.28[b]	0.00	0.02	0.75
ABC (cm)	24.91±0.36[c]	26.44±0.36[b]	27.65±0.36[a]	25.93±.036[a]	26.97±0.36[a]	26.10±0.36[a]	0.00	0.09	0.37
THC (cm)	14.06±0.25[b]	14.75±0.25[ab]	14.95±0.25[a]	14.10±0.25[b]	15.30±0.25[a]	14.37±0.25[b]	0.03	0.00	0.11
EL (cm)	10.54±0.12[a]	10.38±0.12[a]	10.63±0.12[a]	10.54±0.12[a]	10.38±0.12[a]	10.63±0.12[a]	0.35	0.68	0.86
EW (cm)	5.82±0.06[b]	5.68±0.06[b]	6.15±0.06[a]	5.91±0.06[a]	5.91±0.06[a]	5.83±0.06[a]	0.00	0.61	0.39

BB = breed effect; DD = dose effect: D0 = Control; D1 = Normal Dose (4.4 mg / kg bw); D2 = double Dose (8.8 mg / kg bw); NZW = New Zealand White; CAL = Californian; RX = Rex; BL, Body Length; CHC, Chest Circumference; ABC, Abdominal Circumference; THC, Thigh Circumference; EL, Ear Length; EW, Ear Width.

Means within the same row not sharing the same letter within each category (dose, breed) were significantly different (P < 0.05).

evidenced on growth traits and body dimensions but, withdrawal time must be followed to avoid residues in meat and consequently, human health hazard.

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