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PERFORMANCE, PHYSIOLOGICAL PARAMETERS AND CARCASS CHARACTERISTICS OF GROWING CALIFORNI RABBITS REARED in DIFFERENT CAGE DENSITIES.

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ABSTRACT: The current study was carried out into two separate experiments to study the effect of different cage densities on growth performance, physiological parameters and carcass characteristics of growing rabbits. Thirty-six of six-week-old weaned California males and females were used. Both males and females were divided into three different cage density treatments, one animal (single), two animals (double) or three animals (triple) per cage. Feed intake was daily recorded, while body weight weekly measured. In addition, both daily gain and feed conversion ratio are calculated weekly. At the end of the experiments blood samples were collected from all animals, plasma cortisol total protein, albumin, and glucose were measured. At the end of experiment all meals were slaughtered for carcass weight, measurements, parts and individual muscle weight were recorded. The most remarkable results are, high cage density (double and/or triple) significantly decreased ($P<0.05$) feed intake, body weight and daily gain in both males and females. On the other hand, low cage density improved feed conversion ratio($P<0.01$) in males only. On the other hand, high cage density increases ($P<0.05$) plasma cortisol, total protein, globulin and glucose concentration. In addition, high density cages treatments decrease ($P<0.05$) carcass weight, measurements, carcass parts and individual muscle weight. The current study revealed that rearing both meals and females in single cages during growing period improve their performance and carcass characteristics.

Keywords: cage density, feed intake, carcass characteristics, physiological parameters

INTRODUCTION

Cage density is an important managerial factors that can affect profitability of rabbit industry (Villalobos et al., 2010). In addition, cage density affecting profitability through its affects on performance, labor and investment cost (Villalobos et al., 2008). The same authors added that, rabbit's productions requires great labor and investment cost of cages and equipment. Subsequently, increasing cage density decrease investment cost in cage and equipment, but negatively affect animals' performance(Aubret and Duperray, 1993; Mbanya et al., 2004). Moreover, European commercial farms use cage density from 14 to 23 rabbits/m2 (from 425 to 720 cm2 /rabbit) (Trocino and Xiccato, 2006). In addition, to prevent rabbits' behavior disturbance during fattening, the European Food and Safety Authority (EFSA, 2005) recommended a maximum density of 40 kg/m^2 (or a minimum surface of 625 cm^2/rabbit). Rabbits reared under high densities decrease their feed intake through spending less time for eating (Morisse and Maurice, 1997). In addition, Maertens and De Groote (1984) found that rearing more than 19 rabbits/m^2 reduces both feed intake and growth rate, without any effect on feed efficiency and mortality rate. Moreover, high density significantly increased plasma cortisone, total protein and albumin (Kalaba, 2012). Many researchers stated worsen in carcass and meat quality with increasing density (Dal Bosco et al., 2002; Dalle Zotte et al., 2009; Princz et al., 2009; Trocino and Xiccato, 2006). Therefore, the aim of the current experiment is to study the effect of cage density on males and females' performance, blood biochemistry and males' carcass and meat quality.

MATERIALS AND METHODS

This study was carried out as two separate trails during the period from February 13th to April 12th, 2017 at the Poultry Research Farm, Poultry Production Department, Faculty of Agriculture, Assiut University, Assiut, Egypt.

Experiment design

The current study is divided to two separate experiments to study the effect of cage density on the growth performance and carcass characteristics of growing California male and female rabbits. In the first experiment thirty-six of six-week-old weaned California male rabbits were used and divided into three cage density treatments, the first treatment (Single male rabbit) six males were housed in individual battery cage (sex replicates). The second treatment (two male rabbits) 12 males were housed in pairs in battery cage (sex replicates) too. The third treatment (Triple male rabbits) 18 males were housed as 3 males per battery cage (sex replicates). The battery cage dimensions were 64 cm width ×62 cm length ×48 cm height in each cage density. Subsequently, the number of cages was equal (6 battery cages as replicates) in all treatments. The second experiment was designed typical to the first experiment, except the males were replaced with females. The two experiments started at the same time. All rabbits were provided a concentrate meal in flat-bottomed earthen pots at 8.00 AM. The concentrate feed used in the current study is a registered commercial product (No. 1/8397 Egyptian Ministry of Agriculture). The concentrate feed components are alfalfa (17% CP), yellow corn, soybean meal (46% CP), sunflower meal (28%), Di-Ca-Phosphate (1781), CaCo3, mineral and vitamin premix (3779). Feed intake was daily recorded, while body weight

weekly measured. In addition, both daily gain and feed conversion ratio are calculated weekly (from 6 to 13 weeks of age).

Blood samples

At the end of the experiments (13 weeks of age) blood samples were collected from all animals (males and females). Blood samples were taken at 8: am after overnight fasting in sterilized disposable evacuated tube containing anticoagulant (heparin). Subsequently, blood samples were centrifuged at 1000 x g for 15 minutes and stored in -20C˚ for later analysis. The analysis of cortisol level in plasma was performed using a commercial ELISA kit (Rabbit Cortisol ELISA Kit, Houston, Texas, USA). To establish the calibration curves in plasma, a standard curve was Created by reducing the data using Assayfit pro (AssayCloud com., Nijmegen, Netherlands) computer software. Assayfit pro software is capable of generating a four-parameter logistic (4-PL) curve-fit. Plasma total protein, albumin, and glucose were measured using local commercial colorimetric assay kits (Spectrum Diagnostics, Egypt). Globulin was calculated as the difference between total protein and albumin.

Carcass characteristics

At the end of experiment all males were slaughtered after overnight fasting (8 hrs). Males were slaughtered by cutting the jugular veins and carotid arteries following the Islamic tradition (Halal procedure). Carcass dissection was proceeded according to Blasco and Ouhayoun (1996). Directly, after slaughtering the skin was removed and the commercial skin weight was recorded. Next, the carcass was dissected, and offal was obtained and weighed (Head, full gastrointestinal, heart, lungs, liver, spleen, testes and kidneys). Subsequently, the hot carcass weight (HCW) was recorded during the first 15-30 from slaughtering. After one hour from slaughtering, carcass was chilled (0-4°C) in refrigerator for 24 hours. Then, the chilled carcasses were weighed (CCW), and carcass measurements (Dorsal length, thigh length and Lumbar Circumference) were recorded according to Blasco and Ouhayoun (1996). The reference carcass weight (RCW) was calculated by Subtraction the head weight and Thoracic cage contents from chilled carcass. Subsequently the carcass was divided to for commercial parts, each part was weighted separately, as follow fore leg weight (FLW), thoracic cage weight (TW), lion weight (LW) and hind part weight (HPW). Thereafter, six different major muscles (longissimus dorsi, biceps femoris, gastrocnemius, front triceps, gluteus medius and vastus lateralis) were dissected and weighted. Subsequently, longissimus dorsi muscle was used for meat chemical analysis.

Statistical analysis

The experimental data were statistically analyzed as one-way ANOVA in RCBD design with the model: $Y_{ij} = \mu + T_i + B_J + \epsilon_{ij}$. Where, Yij is the observation, μ is the general mean, T_i is the effect of i^{th} treatment, B_J is the effect of J^{th} block, ϵ_{ij} the error related to individual observation. In the current study the animals were blocked to six different initial body weight categories and the animal within each block randomly assigned to the experimental treatments. Moreover, the body weight and daily gain were analyzed as repeated measures. The data were analyzed using the GLM procedure of SAS (SAS, 2013) . Differences among means were tested using Duncan's multiple-range test (Duncan, EFSA,1955).

RESULTS

Body weight and daily gain

Body weight and daily gain of rabbits in the different three treatments of the two experiments are represented in Table (1). For males, first experiment, the initial body weight of the three groups was not significant. Moreover, no significant differences were obtained in body weight at 8 weeks of age. On the other hand, the body weight of the single males showed significant ($P<0.05$) increase as compared with triple males. While, the double males didn't differ from either single or triple male. Similarly, at 10 weeks of age both single and double males had higher ($P<0.01$) body weight than the triple males. Moreover, the final weight at 13 weeks of age showed a highly significant ($P<0.01$) increase of single males' weight when compared with the other two groups. In addition, double males had higher ($P<0.01$) final body weight compare with the triple males.

Similarly, no differences were obtained in body weight of females' rabbits reared in different cage densities during the 6 and 8 weeks of age. In contrast, at the end of 10 weeks of age both single and double females had higher ($P<0.01$) body weight than triple females. By the end of week 12, single females had higher ($P<0.01$) body weight than doubles or tribbles females. The final body weight results were the same as week 10^{th}.

Daily gain of males and females reared under different cage densities is presented in Table 2. Single males had significant higher($P<0.01$) average daily gain (Table 2) and total gain than both doubles and triple males. Moreover, double males had higher ($P<0.01$) average daily gain and total gain than triples males. For the second experiment, single females had higher ($P<0.05$) average daily gain than triple females. While, the double females had non-significant intermediate average daily gain. Moreover, both single and double females had higher total gain than triple females. On the other hand, no difference was found in total gain between single and double females.

Feed intake and feed conversion ratio

Feed intake and feed conversion ratio for both males and females are represented in Table (2). In both experiments the feed intake results were similar. In addition, single males and females had higher ($P<0.01$) feed intake as compared with double and triple rabbets. Moreover, double males and females consumed more ($P<0.01$) food than triple males and female, respectively. Single males had less ($P<0.01$) feed to gain ration than triples. For the females the three groups had similar feed conversion ratio.

Blood plasma constituents

Plasma biochemistry are showed in Table (3). Single males had significant lower ($P<0.01$) plasma cortisol concentration than both double and triple males. Moreover, triple males had higher ($P<0.01$) cortisol level than double males. In addition, plasma cortisol concentration in different females' groups was similar to males' groups. Both single and double females had lower ($P<0.01$) plasma cortisol level than triple females. Also, single females had lower ($p<0.01$) plasma cortisol than double females.

Plasma total protein, albumin and globulin are shown in Table (3). Both total protein and globulin results were in the same line in the two experiments. Triples males and females had higher ($P<0.01$) plasma total protein and globulin than both double and single males and females, respectively. In addition, single males and females had lower ($P<0.01$) plasma total protein and globulin than double males and females,

respectively. In contrast, no differences were found among different males and females' groups in their plasma albumin level. The calculated albumin to globulin (A/G) ratio was shown in Table (3). Single males had higher (P<0.01) A/G ratio than both double and triple males. Also, double males had higher (P<0.01) A/G ratio than triple males. In the second experiment, single females had higher (P<0.01) A/G ratio than both double and triples females. On the other hand, both double and triples females had similar A/G ratio.

Plasma glucose concentration results are shown in Table (3). The differences in plasma glucose among different males and females' density groups was identical to cortisol, total protein and globulin differences. Triples males and females had higher (P<0.01) plasma glucose concentration than both double and single males and females, respectively. In addition, single males and females had lower (P<0.01) plasma glucose concentration than double males and females, respectively.

Organs and fat storages

Organs and fat storages are shown in Table (5). Moreover, single males had significant high (P<0.05) skin and head weight as compared with double and triple males. No significant differences were obtained between double and triple males in their skin and head weight.

Internal organs weight (gastrointestinal, heart, lungs, liver, spleen, kidneys and tests) are shown in Table (5). Single rabbit in cage had significant (P<0.05) higher lungs and liver weight than Triple rabbits in cage. In contrast, the double males had a non-significant intermediate value of lungs and liver weight. On the other hand, both single and double males in cage had higher (P<0.05) kidneys weight than triple males in cage.

Fat storages (perirenal, scapular and inguinal fat) are presented in Table (5). The only significant difference in fat storages was in perirenal fat. In addition, double males had higher (P<0.05) perirenal fat than single and triple males, no significant difference was found between single and triple males.

Carcass characteristics and individual muscle weight

Slaughter weight, carcass, carcass parts, carcass measurements and individual muscles weight are shown in Table (4). Single males had higher (P<0.05) slaughter weight than triple males. While, double males had non-significant intermediate slaughter weight. Single males had higher (P<0.05) hot carcass, chilled carcass and reference carcass weight than the two other cage density groups. In contrast, no differences were observed in hot carcass, chilled carcass and reference carcass weight between double and triple males.

Carcass measurements (dorsal length, thigh length and lumber circumference) are shown in Table (4). No differences were observed among the three battery cage groups in Carcass measurements.

The four-carcass parts weight (fore legs, thoracic cage, lion and hind limbs) are shown in Table (4). No difference was found among three battery cage groups in their fore-legs weight. On the other hand, single males have higher (P<0.05) thoracic cage, lion and hind-limbs weight than triple males. In contrast, double males had non-significant intermediate values of thoracic cage, lion and hind-limbs weight.

Moreover, individual dissected muscles weights are shown in Table (4). The only significant (P<0.05) difference in muscle weight was in LD muscle. In addition, single males had higher LD weight than triple males in cage, while double males

had non-significant intermediate LD weight.

Meat chemical analysis (moisture, protein, fat and Ash) are presented in Table (6). No differences among the density group in their meat chemical analysis.

DISCUSSIONS

Low body weight and daily gain associated with high cage density in both males and females have been observed previously (Aubret and Duperray, 1993; Maertens and De Groote, 1984; Matics et al., 2019; Mbanya et al., 2004). The direct cause of negative effect of high cage in density on body weight and daily gain is assumed to be low feed intake of rabbits reared on high density (Aubret and Duperray, 1993; Matics et al., 2019). In addition, the current study showed a decrease in feed intake of both females and males reared under high densities. Moreover, many authors have used glucocorticoid (GC) concentrations as an evidence of chronic stress (Mendoza et al., 2000). In addition, in many studies GC level elevated with increasing animal density and/or decreasing space allowance (Barnett et al., 1992; Gupta et al., 2007; Villagra et al., 2009). Subsequently, body weight and gain of animals are adversely affected by increased levels of GC as a result of stimulating somatostatin secretion from hypothalamic. Thereafter, somatostatin inhibits growth hormone (GH) secretion from the anterior pituitary (Manuja et al., 2012). Moreover, Manteca et al. (2016) explained the negative effect of stress on feed intake as a results from a complex interplay among, glucocorticoids, leptin and corticotropin releasing factor. These findings are in line with the current results which appear in Table 2. In the current study, feed conversion ratio impaired in triple males (high density). These results are similar to those found by Dal Bosco et al. (2002) and Princz et al. (2009).

In the current study, blood biochemistry provided another evidence of increasing stress in high density rabbits. In addition, cortisol concentration was significant higher in high density cages in both males and females. High density cage causes a stress to increases the level of ACTH (Munksgaard and Simonsen, 1996). Subsequently, high level of ACTH increase plasma cortisol concentration (Cook, 2009). Moreover, increased cortisol level with high rabbits cage in density have been found by Kalaba (2012). In addition, Van Hunsel et al. (1998) stated stress increases total protein and globulin levels in blood which agreed with the current study results. In accordance with the present results, Onbaslar and Onbaslar (2007) and Kalaba (2012) showed an increase in plasma glucose level with increasing cage density.

The improvement of the slaughter weight of law density cage rabbits is directly caused by increased feed intake of those rabbits which appears in table 3. In addition, Princz et al. (2009) explain the low feed intake and slaughter weight of high density reared rabbits causes an aggressive behavior which decrease feeding time and subsequently, feed intake. As a result of increased slaughter weight, the carcass weight and its parts increased in low density cages compared with high density cages. The dressing percentage, and different carcass parts percentage (data not shown) did not affected by cage density, which means the cage density affect carcass weight without any effect on carcass composition. In addition, no changes were found in meat chemical composition. Those results are agreed with many studies(Dal Bosco et al., 2002; Dalle Zotte et al., 2009; Matics et al., 2019; Onbaslar and Onbaslar, 2007; Szendrő and Dalle Zotte, 2011).

CONCLUSION

From these results it be concluded that, the high cage density specially in males cause aggressive behavior which developed a stress on high density reared rabbits. Both aggressive behavior and stress impaired rabbits' performance through decreasing Growth performance traits, feed efficiency, and finally carcass characteristics, especially under hot climatic condition.

Table(1): Body weight of males and females in different densities during experiment period

Items	Initial weight	Weight 2	Weight 4	Weight 6	Final Weight
Males					
Single	953.75±202.77	1204.00±210.68	1633.50±234.35[a]	1903.50±195.89 [A]	2334.00±147.62 [a]
Double	957.17±130.85	1052.00±115.70	1411.33±122.03 [a b]	1626.33±117.38 [b]	1999.67±66.32 [b]
Trible	957.22±85.31	1139.56±97.65	1255.33±89.10 [B]	1446.11±76.78 [B]	1742.89±84.37 [C]
P -value	P = 0.9991	P = 0.5939	P = 0.0138	P = 0.0016	P = 0.0002
Females					
Single	737.50±64.18	881.00±68.90	1372.50±73.48 [A]	1628.50±104.21 [A]	1982.00±80.83 [A]
Double	740.00±43.72	905.00±42.32	1302.33±47.79 [A]	1413.33±70.92 [B]	1757.67±73.70 [A B]
Trible	741.67±33.24	834.44±27.75	1093.33±39.35 [B]	1249.56±44.32 [B]	1687.56±68.08 [B]
P-value	P = 0.9807	P = 0.1802	P = 0.0006	P = 0.0029	P = 0.0393

a, b and c Means within the same column with different superscripts for each factor are significantly different (P<0.05)

Table (2): Average daily gain, feed intake , feed conversion and total gainratio of males and females rabbits at different densities.

Items	Daily gain, g	Feed intake, g	Feed conversion	Total gain
Males				
Single	24.65±1.13 [A]	175.80±1.27 [A]	7.14±0.31 [B]	1244.50±34.54 [A]
Double	18.62±1.48 [B]	141.68±1.33 [B]	7.61±0.65 [AB]	1017.67±38.12 [B]
Trible	14.03±0.95 [C]	124.22±1.68[C]	8.85±0.60 [A]	945.89±83.18 [C]
P -value	P <0.0001	P <0.0001	P = 0.0100	P <.0001
Females				
Single	22.22±0.62 [A]	172.65±0.94 [A]	7.77±0.24	1244.50±34.54 [A]
Double	18.17±0.68 [AB]	146.03±1.49 [B]	8.04±0.37	1017.67±38.12 [A B]
Trible	16.89±1.49 [B]	132.29±0.63 [C]	7.83±1.12	945.89±83.18 [B]
P -value	P = 0.0263	P <.0001	P = 0.8980	P = 0.0463

a, b and c Means within the same column with different superscripts for each factor are significantly different (P<0.05)

Table (3): Plasma constituents of males and females rabbits at different densities at the end of experiment.

Items	Cortisol µg/dl	Total protein,	Albumin g/l	Globulin g/l	Albumin /globulin	Glucose mg/dl
Males						
Single	1.00±0.00 C	53.86±0.1 C	30.64±0.15	23.22±0.11 C	1.32±0.01 A	113.56±0.50 C
Double	1.26±0.01 B	55.08±0.1 B	30.66±0.28	24.42±0.26 B	1.26±0.02 B	120.78±1.21 B
Trible	1.79±0.01 A	56.58±0.1 A	30.43±0.20 A	26.15±0.23 A	1.16±0.02 C	139.78±0.88 A
P value	P <0.0001	P <0.0001	P =0.7020	P <0.0001	P <0.0001	P <0.0001
Female						
Single	1.00±0.01 C	51.92±0.4 C	29.66±0.34	22.27±0.19 C	1.33±0.02 A	111.28±0.49 C
Double	1.25±0.01 B	53.85±0.4 B	29.44±0.24	24.41±0.20 B	1.21±0.01 B	117.15±1.17 B
Trible	1.44±0.02 A	56.01±0.1 A	30.12±0.20	25.89±0.23 A	1.16±0.02 B	130.77±0.16 A
P value	P <0.0001	P =	P = 0.2035	P <0.0001	P <0.0001	P <0.0001

a, b and c refer to means within the same column with different superscripts for each factor are significantly different (P<0.05)

Table (4): Carcass weight, carcass measurements, carcass parts and individual muscle weight of male rabbits at different densities.

Items	Different density groups			
	P value	Single	Double	Triple
Slaughter weight (g)	P= 0.05	2189.50±144.10	1926.00±110.99	1749.50±96.24
Hot Carcass weight (g)	P=0.05	1204.25±88.21	1043.25±76.38 B	972.50±30.57 B
Dressing wet (%)	P=0.778	60.76±0.88	59.56±1.33	60.48±1.13
Chilled carcass wet (g)	P=0.05	1127.25±79.08	970.00±71.97 B	899.00±34.87 B
Reference Carcass	P=0.01	1011.00±73.71	862.75±67.80 B	791.00±33.09 B
Thoracic cage content (g)	P=0.069	34.03±3.93	25.71±1.37	24.17±2.57
Fore legs weight (g)	P=0.182	272.25±24.33	241.25±26.18	226.75±11.16
Thoracic cage weight (g)	P=0.05	101.50±13.46 A	73.00±4.63 AB	63.25±3.49 B
Lion weight (g)	P=0.01	247.50±6.88 A	207.00±17.18 B	182.25±10.96 B
Hind limbs weight (g)	P=0.05	389.75±26.42 A	341.50±22.80 AB	318.75±13.94
Longissimus dorsi (g)	P=0.05	46.07±2.86 A	39.62±3.02 AB	32.25±1.76 B
Biceps femora's (g)	P=0.985	15.33±0.81	15.33±2.17	14.95±1.95
Gastrocnemius (g)	P=0.385	10.20±1.03	10.41±0.73	8.78±0.85
Triceps (front) wet (g)	P=0.062	3.17±0.44	2.22±0.13	2.02±0.31
Gluteus Medius (g)	P=0.156	9.99±0.24	8.34±1.36	6.15±1.30
Vastus Lateralis (g)	P=0.197	10.76±0.93	7.93±1.05	10.88±1.49
Dorsal length (cm)	P=0.347	23.75±.75	24.00±1.00	22.00±1.08
Lumbar Circumference(cm)	P=0.098	9.25±0.48	9.25±0.32	9.00±0.41
	P=0.177	15.88±0.43	14.50±0.65	14.88±0.31

a, b and c Means within the same column with different superscripts for each factor are significantly different (P<0.05)wet: weight

Table (5): Organs and fat storages weight of male rabbits at different densities.

Items	P value	Different density groups		
		Single	Double	Trible
Slaughter weight	P= 0.0167	2189.50±144.10 ^{A}	1926.00±110.99	1749.50±96.24 ^{B}
Skin weight (g)	P=0.0381	424.00±28.54 ^{A}	352.50±21.64 ^{B}	332.50±15.52 ^{B}
Head weight (g)	P=0.0410	116.25±5.88 ^{A}	107.25±4.48 ^{B}	108.00±3.11 ^{B}
Gastrointestinal	P=0.7115	340.75±18.25	324.25±26.51	309.00±33.93
Heart weight (g)	P=0.4591	6.49±0.31	6.05±0.23	5.74±0.25
Lungs weight (g)	P=0.0368	17.68±1.89 ^{A}	14.29±0.89 ^{AB}	11.49±1.30 ^{B}
Liver weight (g)	P=0.0347	95.87±15.66 ^{A}	79.71±6.35 ^{AB}	58.26±7.90 ^{B}
kidneys weight	P=0.0429	16.65±1.50 ^{A}	16.77±1.12 ^{A}	12.91±0.62 ^{B}
Testes weight (g)	P=0.2222	6. 60±0.81	5.77±0.61	5.43 ±0.71
Spleen weight (g)	P=0.1131	1. 02±0.09	1.25±0.06	1.38 ±0.16
Perirenal fat (g)	P=0.0321	10.12±1.44 ^{B}	23.50±4.78 ^{A}	4.99±0.52 ^{B}
Scapular fat (g)	P=0.9540	5.36±1.89	4.61±1.62	5.18±0.72
Inguinal fat (g)	P=0.7092	2.31±0.27	2.47±0.64	4.69±2.96

a, b and c Means within the same column with different superscripts for each factor are significantly different (P<0.05)

Table (6): Meat chemical analysis of males in different densities.

Treatments	Moisture %	Protein %	Fat %	Ash %
Single	74.77 ±0.03	21.43 ±0.02	2.53 ±0.01	1.28 ±0.01
double	74.78 ±0.03	21.39 ±0.02	2.53 ±0.01	1.29 ±0.02
triple	74.88 ±0.03	21.35 ±0.01	2.53 ±0.01	1.24 ±0.01
P value	P = 0.9852	P = 0.8462	P = 0.6543	P = 0.3297

All values were not significant.

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الملخص العربى

الاداء والخصائص الفسيولوجية وخصائص الذبيحة لارانب الكالفورنيا الناميه المرباه في بطاريات بكثافات مختلفه

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اجريت الدراسة الحاليه على تجربتين منفصلتين لدراسة تأثير كثافة البطاريات على الاداء والخصائص الفسيولوجية ومواصفات ذبائح كل من اناث وذكور سلالة كالفورنيا النامية. تم استخدام 36 ذكر و 36 انثي من ارانب سلالة كالفورنيا حديثة الفطام. كل من الذكور والاناث تم تقسيمهم الي ثلاث مجموعات مختلفه من حيث كثافة البطاريات. المجموعه الاولي أرنب واحد في كل صندوق (مفرد) والمجموعه الثانية ارنبين لكل صندوق (ثنائية). والمجموعه الثالثة ثلاث ارانب لكل صندوق (ثلاثيه). تم تغذية الارانب في غذايات فخاريه تحتوي على عليقه مركزه تجاريه قدمت الساعة الثامنة صباحا يوميا.تم تسجيل كمية الغذاء الماكوله يوميا بينما تم تسجيل وزن الجسم اسبوعيا كما تم أيضا حساب كلا من معدل الزيادة الوزنية اليومية كفائة التحويل الغذائي اسبوعيا.في نهاية فترة التجربه تم سحب عينات دم من كل الذكور والاناث بالتجربه وتم تقدير مستوي البروتين والالبيومين وحساب الجلوبيولين وكذلك تم تقدير هرمون الكورتيزول ومستوي الجلوكوز في البلازما. كما تم ذبح جميع ذكور التجربه وتقدير وزن الذبيحة ومكوناتها وقياساتها وكذلك وزن بعض عضلات الذبيحه بعد تشريحها. وكانت اهم النتائج المتحصل عليها ان كثافة البطريات العالية (الثنائية والثلاثية) ادت الي انخفاض معنوي ($P<0.05$) لكمية الغذاء المأكول ووزن الجسم ومعدل الزيادة اليومية في كلا من الذكور والاناث. ومن ناحية اخرى فان الكثافة المنخفضة (الحيوانات الفرديه) أدت الى تحسين معنوي ($P<0.01$) في كفاءة تحويل الغذاء في الذكور. وعلى صعيد اخر فان الكثافة المرتفعة ادت الى زيادة ($P<0.05$) معدلات الكورتيزول والبروتين الكلي و الجلوبيولين وكذالك مستوى الجلوكوز في بلازما الدم. بالاضافة الى ان كثافة البطريات المرتفعة ادت الى انخفاض ($P<0.05$) في وزن الذبيحه واجزائها وقياساتها وكذلك وزن العضلات بها. وعلى هذا فان الدراسة الحالية قد اوضحت ان تربية ذكور واناث الارانب من سلالة كالفورنيا بصوره مفردة ادت الي تحسين أداء الذكور والاناث وخصائصه الفسيولوجيه وكذلك صفات الذبيحة في الذكور.