14th Conf. Agric. Develop. Res., Fac. of Agric., Ain Shams Univ., March, 2019, Cairo, Egypt
Special Issue, 27(1), 861 - 868, 2019
Website: http://strategy-plan.asu.edu.eg/AUJASCI/

EFFECT OF DIFFERENT GROUP SIZE ON THE PRODUCTIVE PERFORMANCE OF GROWING RABBITS

[78]

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Received 24 November, 2018, Accepted 9 December, 2018

ABSTRACT

This study was carried out to investigate the effect of different group's size on productive performance of growing rabbits. A total number of 108 APRI weaning rabbits, their average initial body weight were 560±10g. Animals were assigned to two groups: The 1st group housed by 4 rabbits in cage 60 cm^2, while the 2nd group housed by 8 rabbits in cage 120 cm^2. During the experimental period live body weight(g), daily feed intake(g) and mortality rate (%) were recorded and daily body weight gain(g) and feed conversion ratio(FCR) were calculated at 5, 8, 10 and 12 weeks of age. After the end of the experiment (12 wk) 36 rabbits were randomly taken and slaughtered to calculate the measure carcass traits. These include total giblet (g), cervix part (%), front quarters (%), intermediate part (%), hind quarter (%) and the dressing weight. Also the economical efficiency (EE%) was calculated.

Results indicated that: the average live body weight (LBW), daily weight gain (DWG) and daily feed intake (DFI) were not significantly influenced by different group size. The best DWG values were recorded for the group 2 (8 rabbits/ cage), by around 2.5% during the whole fatting period (5-12 wks). Daily feed intake was lower in group 2 than group 1 by around 6.20%, 2.00%, 0.31% and 2.83% at 5, 8, 10 and 12 weeks of age, respectively. Data revealed significant improvements in FCR for rabbits in group2 ($P<0.05$) than group1 for the period 5-8 and during the whole growing period 5-12 weeks. The mortality rate was lower in group 2 than in group 1. The best dressing weight value was recorded for the group 2 by around 9.2%.The economical efficiency (EE %) was improved in group 2. It is concluded that, increasing number of rabbits to 8 rabbits in cage could decrease the mortality %, increase the dressing weight that also lead to increase the economical efficiency.

Keywords: Rabbit, group size, productive performance, economical efficiency.

INTRODUCTION

Rabbits provide an excellent meat for human consumption and may play a significant role in solving a part of meat shortage in Egypt.

In nature, the home range and group size or size of warren are determined by the risk of predation, the vegetative covering of the area and the quality of the soil. When wild animals such as European wild rabbits in nature choose a habitat (move to another location, decide to live alone, in small or large groups and in several other situations), it appears that they seek to balance benefits and costs.

Many animal species live in groups. One of the most important benefits of group living is the vigilance of flock mates, which is essential in detecting predators in time **(Kutsukake, 2009)**.

It must be borne in mind that benefits and costs on farms differ from those in nature. Artificially reproducing natural conditions may prove disastrous because some of the biggest advantages (e.g., a group living as a defence against predators) are

not applicable. **(Mbanya et al 2004)** found that the increase of animals per cage reduces investment costs in cages and equipments, but it worsens animal performance. The European Food and Safety Authority (EFSA) (2005) recommended a minimum surface of 625 cm^2/ rabbit and not more than 40 kg/ m^2 at the end of fattening, in order to avoid disturbances in rabbit behavior. However, the behavior of rabbits depends on their age. Rabbits at the end of fattening preferred lower densities, and when caged at high densities spent less time for eating **(Morisse and Maurice, 1997).** Densities higher than 19 rabbit/m^2 reduced feed intake and growth rate, with no effect on feed efficiency and mortality **(Aubret and Duperray, 1992).**

Hoy and Verga (2006) concluded the main welfare indicators for farmed rabbits: no or low mortality, the morbidity should be low or unavoidable, the physiological parameters should be in the species-specific standard and exhibition of species-specific behaviours and the productive performance should be at a normal level.

Therefore, the present work was designed to investigate the effects of group size to APRI on productive performance, carcass traits and economic efficiency.

MATERIALS AND METHODS

Experiments of the present study were carried out at Sakha Research Station, kafer El-Sheikh Governorate, Animal Production Research Institute (APRI), Agriculture Research Center (ARC), Ministry of Agriculture, Dokki, Giza, Egypt during the period from November 2016 to January 2017.

Experimental Animals

A total number of 108 APRI rabbits were used in the present study reared from weaning to the end of experiment (from 5wk to 12wk of age). Average initial body weight of individual rabbits was 560±10g. Rabbits were randomly divided into two groups in 9 replicate: The first group housed by 4 rabbits in cage 60 cm^2 and second group housed by 8 rabbits in cage 120 cm^2. Rabbits were kept in tiered cages were equipped with two feeders and nipple for automatic drinking. Animals were healthy and clinically free of external and internal parasites and there were kept under the same managerial and hygienic conditions according to the farm routine work.

Experimental diets

Experimental diets were formulated to be approximately similar in crude protein (CP) levels and digestible energy (DE), (17% CP and 2550 kcal DE per per kg diet, **Table 1**). The diets are formulated to meet the recommendations of the National Research Council for Rabbits **(NRC, 1977)**.

Measurements and observations

During the experimental period live body weight (g), daily feed intake(g) and mortality rate (%) were recorded and daily body weight gain(g) and feed conversion ratio (FI g/BWG g) were calculated at 5, 8, 10 and 12 weeks of age. After the end of the experiment all period (12 wk), 36 rabbits (two from each group, four from each replicate) were randomly taken and slaughtered to calculate the economical efficiency (EE%) and measure carcass traits.

The skin was loosened and peeled from the hocks. A cut was made around the anal opening and between the hind legs, and then the entrails were removed. The giblets (liver, heart, spleen, lungs and kidneys) were separated and weighed. The carcass was weighed after discarding feet, viscera, fur and tail.

The carcass was cut in the following points: cut-point 1, section between the 7^{th} and 8^{th} thoracic vertebrae; cut-point 2, section between the last thoracic and the first lumbar vertebra, following the prolongation of the 12^{th} rib when cutting the thoracic wall; cut-point 3, section between the 6^{th} and 7^{th} lumbar vertebra, cutting the abdominal wall transversally to the vertebral column; cut-point 4, separation of fore legs including insertion and thoracic muscles according to **Blasco et al (1993)**. The cut-point 1, FL: Fore-quarter% (fore legs) including thoracic insertion muscles, cut-point 2, chest% (thoracic cage which included the first seven ribs, without the insertion muscles of the fore legs); cut-point 3, lion% (L) (including abdominal wall and the ribs after the 7^{th} thoracic rib); cut-point 4, Hind leg% (HL) (including the sacral bone and the lumbar vertebrate after the 6th lumbar vertebra). Fore-quarter%, Chest%, L% and HL% are percentage of dressing weight. The dressed carcass (saleable carcass) was considered the eviscerated carcass plus the giblets and head. All records were expressed as a relative to live body weight.

Table 1. Composition and Calculated analysis of the experimental diets

Ingredients	(kg /100 kg)
	C
Barley	17.10
Alfalfa hay 12%	24.50
Wheat Bran	25.08
Soybean meal (44%)	19.60
Yellow corn	7.00
Limestone	1.08
Salt (NaCl)	0.35
Premix*	0.30
Molasses	3.00
Calcium di-Phosphate	1.71
Anticoccidea	0.10
Antifungi	0.10
DL methionine	0.08
	Calculated analysis**
DE(kcal/kg diet)	2500
Crude Protein%	18.00
Crude Fiber %	13.40
Crude Fat %	1.90

*Premix contains per kilogram : Vit. A 2000000 IU; Vit. D 150000 IU; Vit. E 8.33 g; Vit. K 0.33 g; B1 0.33 g; Vit. B2 1g; Vit. B6 0.33 g; Vit. B9 8.33 g; Vit. B12 1.7 mg; Pantothenic acid 3.33 g; Biotin 33 mg; Folic acid 0.83 g; Choline Chloride 200 g; Zn 11.7 g; Fe 12.5 g; Cu 0.5 g; I 33.3 mg; Se 16.6 mg; and Mn 5 g. **According to **NRC (1994)** and According to **AOAC (1995)**.

Economical efficiency (EE)

The economical efficiency (EE%) was calculated using the selling price of weight gain and the feeding cost of this gain prevailing in the market, assuming that other costs were constant, **(North, 1981)**.

EE%= ((Selling cost of obtained gain – Feeding cost of this gain) / (Feeding cost of this gain)) x 100.

Statistical analysis

Data were statistically analyzed using Analysis of Variance procedure using the General Linear Model Program (GLM) of SAS (1999) using the following model:

$$Y_{ijk} = \mu_i + G_j + R_k + e_{ijk}$$

Where:

Y_{ij} = The observed value of a given dependent variable

μ_i = Overall adjusted mean

G_j = Effect of studied factor j^{th} due to group, j= 1 and 2

R_k = Replicate of treatment k^{th} due to replicate, k= 1 to 9

e_{ij} = Error of the model

The differences among means were tested using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Growth performance

1. Live body weight and body weight gain

The effect of group on performance during the growing period (5-12 weeks of age) is shown in Table 2. In general, there were no significant differences in LBW, DWG and DFI among rabbit groups at different experimental periods.

Although, the results showed that DWG was not significantly changed with different group size, but the best DWG values were recorded for the group 2 (8 rabbits/ cage), by around 2.5% during the whole fatting period (5-12 wks).

The results are in close agreement with many authors who reported non-significant effect in LBW and DWG of growing rabbit by using different group size. The slow growth rate can be related to high locomotory activity because part of the ingested energy is used for this purpose **(Princz et al 2009 and Szendrő and Dalle Zotte, 2011))**.

On the other hand, these results are different than what has been observed by **(Maertens and Van Herck, 2000; Lambertini et al 2001; Maertens and Van Oeckel, 2001; Dal Bosco et al 2002 and Jehl et al 2003**) who showed that different size group was significantly affected on some productive traits like the decline in daily weight gain and the reduction was between 1.0 and 9.3 g/day and also different than what has been reported by many authors with (**Combes et al 2010 and Khairy et al 2018**) who found that final weight has been significantly reducted between 33 and 445g.

2. Daily feed intake and feed conversion ratio

Daily feed intake of rabbits as influenced by different group size and growing period are presented in **Table (2)**. It appears from these results that DFI was non-significantly affected by different group size. This effect was lower in group 2 (8 rabbits/ cage) than group 1 (4 rabbits/ cage) by around 6.20%, 2.00%, 0.31% and 3.83%, respectively. However; the lowest DFI values were recorded for rabbits in group 2 during the whole period (5-12 wks).

This results are in close agreement with those obtained by **Szendrő and Dalle Zotte (2011) and Khairy et al (2018)** and, in some cases, the differences (5–25g/day) were significant (**Maerens and Van Herck, 2000; Dal Bosco et al 2000; Maertens and Van Oeckel, 2001 and Lambertini et al 2001**). Theoretically, when animal energy requirements increase because their movement increases, they consume more feed (**Lambertini et al 2001; Szendrő and Dalle Zotte 2011)**. However, some studies have shown an opposite trend (**Dal Bosco et al 2002 and Princz et al 2009)**

Maertens and Van Herck (2000) observed that during the first days after weaning, kits in pens were very sensitive towards visitors, noise and handling. They ran together and heaped up in a corner of the pen and tried to escape. The authors concluded that housing rabbits in larger groups (larger pens) induces stress for them. This could explain why kits reared in larger groups consumed less feed than those in smaller groups.

Concerning the effect of different group size on FCR data revealed significant improvements in FCR for rabbits in group 2 ($P<0.05$) than group1 for the period 5-8 and during the whole growing period 5-12 weeks. This was probably due to the effect of the high size content of cage **(Szendrő and Dalle Zotte, 2011 and Khairy et al 2018**)

Feed conversion ratio in groups of three to four or six to seven rabbits per cage improved by 0.05–0.20, as compared with individual or bicellular housing (**Szendrő et al 2009**). When group size exceeded seven rabbits per cage, FCR worsened by 0.20–0.50 (**Lambertini et al 2001; Dal Bosco et al 2002 and Princz et al 2009**).

Mortality rate

The effect of different group size on mortality rate is illustrated in **Fig. (1)**. It is clear from these results that the mortality rate was lower in group 2 (8 rabbits/ cage) than in group 1 (4 rabbits/ cage) by 5.71 %.

In most cases, mortality has been observed to be independent of group size (**Maertens and Van Herck, 2000; Maertens and Van Oeckel, 2001; Princz et al 2009 and Szendrő et al 2009**) and **Dal Bosco et al (2002)** using two or 10 rabbits per cage and **Lang (2009)** with 8–22 rabbits per cage detected significant increases in mortality in larger groups. The main reason for this lack of correlation between group size and mortality could be attributed to the common practice of providing medication in the feed **(Szendrő and Dalle Zotte 2011)**.

Carcass traits

Carcass traits of rabbits as influenced by different group size are presented in **Table (3)**. It appears from these results that carcass traits were non-significant affected by different group size. However; total giblet (g), front quarters (%) and intermediate part (%) were increase in large group by 13.20, 14.92 and 0.86, respectively. That is may be related to greater locomotory activity resulting in an increase in the muscle size as reported by **Szendrő and Dalle Zotte (2011).**

However; **Szendrő and Dalle Zotte (2011)** reported that a tendency towards a decrease in the ratio of fore part to the reference carcass (0.2–0.6%) was observed.

There was no definite change in the intermediate part, while the hind part of animals housed in larger groups increased by 0.1–1.7% as reported by **Dal Bosco et al 2002; Dalle Zotte et al 2009; Szendrő et al 2009; Combes et al 2010**. The increase in the hind part is related to greater locomotory activity resulting in an increase in the muscle size. **Dal Bosco et al (2002), Szendrő et al (2009) and Combes et al (2010)** found that the fat deposits decreased with increasing group size. On the other hand, **Khairy et al 2018** found that low group size had a significant effect on hot carcass weight and dressing out percentage.

Table 2. Effect of using different size groups on productive performance of growing APRI rabbits during different experimental periods

Items	Groups	
	G1	G2
Live body weight (g):		
Weaning 5 weeks	559.39±16.20	540.93± 11.45
8 weeks	882.31±26.43	886.76± 18.69
10 weeks	1118.17±34.36	1127.78± 24.30
12 weeks	1369.93±44.73	1365.14 ±30.15
daily weight gain (g):		
5-8 weeks	15.38±0.91	16.47±0.64
8-10 weeks	16.85±1.02	17.22±0.72
10-12 weeks	17.98±1.20	16.95±0.81
5-12 weeks	16.54±0.78	16.82±0.53
daily feed intake (g):		
5-8 weeks	54.64±2.64	51.25±2.64
8-10 weeks	78.73±4.04	77.19±4.04
10-12 weeks	81.73±6.98	81.48±6.98
5-12 weeks	69.26±2.84	67.30±2.84
daily feed conversion ratio (FI/WG):		
5-8 weeks	3.55^{a}±0.15	3.13^{b}±0.15
8-10 weeks	4.67±0.19	4.45±0.19
10-12 weeks	4.55±0.12	5.14±0.12
5-12 weeks	4.10^{a}±0.18	4.00^{b}±0.18

[a,b] Mean with different superscripts in the same row within item differ significantly (P<0.05).

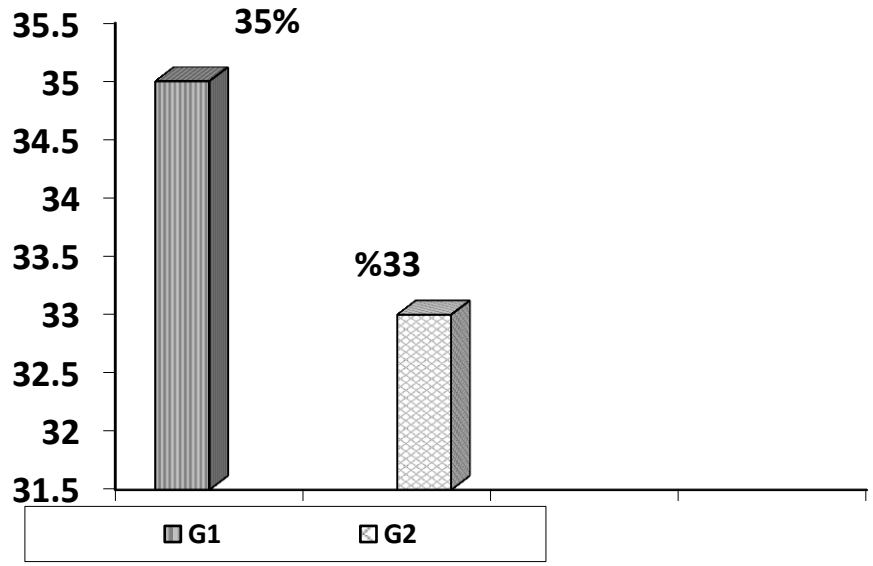

Fig. 1. Effect of using different size groups on total mortality rate of growing APRI rabbits by the end of experimental periods.

Table 3. Effect of using different size groups on carcass traits of growing APRI rabbits at 12 weeks of age

Items	Group		± *SE*
	G1	G2	
Pre-slaughter (g)	1336.94	1493.61	60.55
Total giblet (g)	160.25	181.40	8.35
Cervix part (%)	11.59	11.07	0.32
Front quarters (%)	5.66	6.50	0.67
Intermediate part (%)	7.68	7.74	0.71
Hind quarter (%)	16.69	16.69	0.37
Dressing weight	727.19	800.96	41.31

The economical efficiency (EE %)

The effect of different group size on the economical efficiency (EE %) of rabbit are illustrated in **Table (4).** It is clear from these results that the economical efficiency (EE %) was increase in group 2 by 11.07 %. It could be more economic than size under farm conditions. The main reason for this best of correlation between group size and the economical efficiency could be attributed to the common practice of providing medication in the feed and the decrease in mortality, **Amber (2018)** found that the economical efficiency was decreased from 1.17 to 0.96% as the number of rabbits increased from 2 to 6 per cage.

Table 4. Effect of using different size groups on Input-output analysis and economical efficiency of growing APRI rabbits

Items	G1	G2
Total feed intake diet (kg/rabbit)	4.37	4.02
Total feed cost (L.E.)	13.83	12.70
Average weight gain (kg/rabbit)	1.37	1.36
Selling price (L.E.)(1)	43.84	43.63
Net revenue (L.E.)(2)	30.01	30.93
Economical efficiency(3)	2.17	2.44

(1) Price of kg live body weight was 32 L.E. Commercial diet price (L.E./ton) at 2016 were:2800

(2) Net revenue = Selling price-total feed cost

(3) Economic efficiency = Net revenue/total feed cost

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المؤتمر الرابع عشر لبحوث التنمية الزراعية،
كلية الزراعة، جامعة عين شمس، مارس 2019، القاهرة، مصر
مجلد(27)، عدد(1)، عدد خاص مارس، 861-868، 2019
Website: http://strategy-plan.asu.edu.eg/AUJASCI/

تأثير حجم المجموعات المختلفة على الآداء الإنتاجى للأرانب النامية

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Received 24 November, 2018, Accepted 9 December, 2018

الموجـــــــز

أجريت هذه الدراسة لمعرفة تأثير حجم المجموعات المختلفة على الآداء الإنتاجى للأرانب النامية.استخدم فى هذه التجربة 108 أرنب مفطوم عمر 5 أسابيع من سلالة الأبرى بمتوسط وزن 560±10جرام / أرنب. قسمت الى مجموعتين وكانت كالتالى: المجموعه الأولى تحتوى على 4 أرانب تم اسكانهم فى مساحة 60 سم^2, والمجموعة الثانية تحتوى على 8 أرانب تم أسكانهم فى مساحة 120 سم^2. تم تسجيل بعض النتائج مثل وزن الجسم،الزيادة فى وزن الجسم، كمية الغذاء المأكول، كفاءة التحويل الغذائى وذلك على عمر 12,10,8,5 أسبوع، نسبه النفوق. فى نهاية التجربة (عند عمر 12 أسبوع)، 36 أرنب أختيرت بشكل عشوائى 2 أرنب من كل مجموعة وذبحت لتقدير بعض صفات الذبيحة والقطعيات. و كذالك تم تقدير الكفاءة الإقتصادية.

أظهرت النتائج التالى

لم يتسبب اسخدام اعداد مختلفة فى المجموعات فى احداث اى تأثير معنوى على متوسط وزن الجسم، الزيادة اليوميه فى وزن الجسم و المأكول اليومى، بينما لوحظ ان الزيادة اليومية فى وزن الجسم للمجموعة الثانية والتى تحتوى على (8 ارانب/عين) أفضل من المجموعة الأولى بحوالى 2.5% خلال فترة التجربة (5-12 أسبوع). لم تتأثر كمية الغذاء المأكول بحجم المجموعات المختلفة ولكن سجلت أقل قيمة للأرانب فى المجموعة الثانية عن المجموعة الأولى بحوالى 6.20%، 2% ، 0.31% و 2.83% على التوالى. كان هناك تحسن معنوى فى كفاءة التحويل الغذائى للمجموعة الثانية ($P<0.05$) فى الفترة من عمر 5-8 أسابيع وأثناء الفترة من عمر 5-12 أسبوع. كان لإستخدام مجموعات مختلفة تأثير على معدل النفوق حيث كان معدل النفوق فى المجموعة الثانية له تأثير إيجابى عنها فى المجموعة الأولى. أظهرت المجموعة الثانية زيادة فى الكفاءة الأقتصادية عن المجموعة الأولى.

نستخلص من هذه التجربة أن زيادة حجم المجموعات الى 8 أرانب فى العين 120 سم^2 قد ساهم فى إنخفاض معدل النفوق وزيادة نسبة التصافى فى الذبيحة ومن ثم مردود أقتصادى عالى.

الكلمات الدالة: أرنب، حجم المجموعات، الآداء الانتاجى، الكفاءة الاقتصادية

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