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PRODUCTIVE AND ECONOMIC EFFEICIENCY OF GROWING RABBITS FED TWO LEVELS OF PROTEIN

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ABSTRACT

Eighty male New Zealand White (NZW) rabbits aged 5 weeks, with average body weight 823.17±11.13 g were randomly distributed into two experimental groups (40 each) till 10 weeks of age. The 1st group (T_1) received diet contains 17% CP (low) vs. 19% CP (high) for 2nd group (T_2), respectively. Initial and final body weight (IBW and FBW), feed intake (FI), daily body weight gain (DBWG), feed conversion ratio (FCR), and an economic evaluation were determined.

***Results showed** that the rabbits in T_2 group significantly improved FBW, DBWG and performance index (PI) in T_1. However, daily feed intake (DFI), and FCR were increased in T_1 compared with T_2. Feed intake cost was significantly lower in T_1 than T_2. While, net profit (LE) was significantly higher in T_2. Finally, Rabbits in T_1 were significantly higher in net revenue and relative economic efficiency than rabbits in T_2*

***Conclusively,** from these results it could be concluded that using 19% CP in growing rabbits diet improved productive performance but 17% CP achieve good economic efficiency.*

Key words: Crude protein levels, economic efficiency, growing rabbits.

INTRODUCTION

Protein is an important component for life processes, as a material for renewing and repairing tissues (**Wang *et al.*, 2019**). Nowadays, the rabbits industry is facing several challenges perhaps the most prominent is the increasing price of protein sources in feedstuff. Reducing the cost of feedstuff has become a primary goal for producers, provided that achieving production efficiency.

Feed accounts for the largest part of the production costs in animal production, and could reach up to 70% of total costs according to the investments. Therefore, feed efficiency is a key criterion to improve the sustainability of the farm, both to improve economic balance and to reduce the environmental releases. During last year, rabbit meat production is progressively declining in Egypt due for increasing the price of feedstuff materials as a result of repercussions of Russian-Ukrainian war. Reducing the cost of feedstuff has become a primary goal for producers, provided that achieving production efficiency. The main challenge facing rabbit producers is realizing the balance between decreasing cost and maintaining or increasing benefits (Krupovà *et al.,* 2020). Replacing and reducing protein source is the modern research direction that is carried out to reduce the level of protein in diets for achieving the economic benefit by minimizing the input (Ros-Baró *et al.,* 2022). Feeding low levels of crud protein caused of the reduction of nitrogen excretion, this is of special importance to decreasing the environmental pollution in areas with a high density of animal production (Birolo *et al*., 2022).

Protein sources are the most expensive component in animals and poultry diets, so the try to reduce the level of protein in diets may be achieve economic benefit because the reduction in protein level will be reduce total cost of diets. In addition to the negative effects on rabbits that related to increasing protein levels in diets such as caecal fermentations and alter gut microflora composition and that considered to be among the causes of increased mortality in rabbits (Caraban *et al*., 2009 and De Blas and Mateos 2010).

Hemid *et al*. (2015) reported that productive performance hadn't affected significantly with weaned rabbits when fed diets with different levels of protein. The growth rate of rabbits fed the protein 14.6% diet was close to that of rabbits fed the protein 16.5% diets and FCR was not significantly affected by the different protein levels in diet (Berchiche *et al*., 1995).

Therefore, the aim of this study is to investigate the impact of two protein levels (17 and 19%) in growing rabbit diets on productive performance and economic evaluation of New Zealand White (NZW) growing rabbits.

MATERIALS AND METHODS

Animal and diets:

This experiment was carried out at a private farm of rabbit's production, Menia El-Kamh, El-Sharkia Governorate, Egypt. Experimental design and protocol within this study were conducted according to ethical guidelines approved by the experimental animal care and research ethics Committee of Ain Shams University, Agriculture sector Committee (Approval No 5-2023-3).

Eighty weaning males of New Zealand White (NZW) rabbits about 5 weeks of age with average initial body weight 823.17±11.13 g were randomly distributed into two experimental groups (40 each) till 10 weeks of age during December 2022 to January 2023. The basal diet composition was formulated to cover all essential nutrient requirements for growing rabbits according to NRC (1977). Feed were allowed to a standard pelleted diet all times containing 17% (T_1) or 19% (T_2) crude protein (Table 1). Fresh water was

Table 1. Composition and calculated chemical analysis of the diets fed to rabbits during the experimental period

Ingredients	T_1 (low)	T_2 (high)
Yellow corn	24.00	22.40
Wheat bran	27.00	20.00
Soybean meal (44%)	9.00	17.00
Sunflower meal (36%)	9.00	9.00
Alfalfa (17%)	19.85	18.00
Wheat bran hay	7.30	10.00
Molasses	0.50	0.50
D-Calcium Phosphate	1.55	1.60
Lime stone	1.10	0.80
Salt	0.40	0.40
Premix[1]	0.30	0.30
Total	**100**	**100**
Calculated chemical analysis of diets on DM basis		
DE (Kcal/Kg)	2595	2600
CP%	17.00	19.00
CF%	12.23	12.11
EE%	2.90	3.06

[1] **Each 1 Kg of the Premix contains:** Vit. A 2000000 IU; Vit. D_3 150000 IU; Vit. E 8.33 g; Vit. K_3 0.33 g; Vit. B_1 1 g; Vit. B_2 1.09 g; Vit. B_6 0.33 g; Vit.B_5 8.33 g; Vit. B_{12} 1.7 mg; Pantothenic acid 3.33 g; Folic acid 0.83 g; Biotin 33 mg; Choline chloride 20 g; Mg 66.79 g; Zn 11.79 g; Fe 12.5 g; Cu 0.5 g; I 0.3 g; Se 16.6 mg; Co 1.33 mg and carrier $CaCO_3$ up to 1000 g.

[2] According to **NRC (1977).**

automatically offered all times. Animals were kept under similar management and hygienic conditions and were healthy and clinically free of external and internal parasites. The lighting program provided was 16 hrs. light per day.

Data collection:

Initial and final live body weight (IBW and FBW), feed intake (FI), body weight gain (BWG) and feed conversion ratio (FCR) was recorded. The price of weaning litter (PWL), total feed intake cost (TFIC), total cost (TC), net profit (NP), net revenue (NR), economic efficiency (EE) and economic efficiency (EE) were estimated according to Egyptian marketing price and determined according to El-Speiy *et al*., (2015).

Statistical analysis:

All data were subjected to analysis of variance according to Snedecor and Cochran (1982), using the general linear model (GLM) procedure of base SAS® (SAS, 2002).

The differences among groups means were Duncan's multiple rang test (Duncan, 1955).

RESULTS AND DISCUSSION

Growth performance:

Table 2 showed the effects of crude protein levels in rabbit's diets on LBW, DBWG, DFI, FCR and PI. The results showed that FBW, DBWG and PI significantly (P≤0.05) increased in T_2 in compared to T_1 group. DFI and FCR were significantly lower in T_2 than T_1

Many researchers have studied the effect of dietary protein levels on productive performance of growing rabbits. Although protein levels were different, all researchers thought that low dietary protein levels can reduce productive performance and high dietary protein levels can increase economic profit and gain.

Results agreed with Lie *et al.*, (2004) found that the average daily gain was the highest and feed conversion rate was the lowest when dietary CP reached 20%, namely 34.9 g/d and 2.74:1, respectively. Maximum CP digestibility was 72.1% in the 18% CP group, maximum crude fiber digestibility of 28.4% occurred in the 16% CP group and was significantly different from other treatments (P≤0.05). Lang (1981) and Tang (1987) who reported that the feed conversion ratios for dietary 17%-20% crude protein were higher than that for 16%. Also, Omole (1982) reported that the appropriate crude protein level for meat rabbits was 18%-22%. It is believed that the dietary crude protein requirement of growing rabbits is 16%, which comes from NRC (1977). Wang (1991) pointed out that the average daily gain and feed conversion ratio were the best when the dietary crude protein level was 15.3%-17.9%. Also, Wang (1999) reported that the body gain and feed consumption were ideal when the dietary crude protein level was only 16.5%. Xu (1982) reported that many traits were the best for 6 to 14 week-old rabbits when dietary protein was 17%.

On the other hand, Abo El-Maaty *et al.*, (2023) showed that rabbits fed diet containing low crud protein (15%) supplemented with 3 kg of probiotic ZADO/ton feed had significantly heavier final body weight and increased DBWG, PI and FI compared with control group (17% CP) while, FCR was decreased by 4.46% compared with control group. Birolo *et al.*, (2022) who showed that the different levels of protein in rabbit diets didn’t affected significantly in LBW and BWG of rabbits. Xiccato *et al.*, (2011) who reported that the reducing in protein level in rabbit diets hasn’t significant effect on FCR.

Table 2. Growth performance of NZW rabbits fed two protein levels

Items	Experimental groups		Sig.
	T_1 (low)	T_2 (high)	
IBW, g	837.11 ± 10.08	809.23 ± 12.18	NS
FBW, g	2161.58 ± 17.15 ^{b}	2221.92 ± 20.73 ^{a}	*
DBWG, g	37.84 ± 0.46 ^{b}	40.36 ± 0.56 ^{a}	**
DFI , g	125.06 ± 9.13 ^{a}	121.71 ± 9.05 ^{b}	**
FCR	3.35 ± 0.04 ^{a}	3.03 ± 0.05 ^{b}	**
PI	65.88 ± 1.33 ^{b}	73.96 ± 1.61 ^{a}	**

a, b Means bearing different litter superscripts in the same row differ significantly ($P\leq0.05$).

NS= Non-significant, *= Significant ($P\leq0.05$) and **= Significant ($P\leq0.01$).

IBW= Initial body weight, FBW= Final body weights, DBWG= Daily body weights gain, DFI= Daily feed intake, FCR= Feed conversion ratio and PI= Performance index.

Economic evaluation:

The economic efficiency (EE) of using two levels of crude protein in rabbits diet showed that the rabbits which received low crude protein (T_1) achieved the best significant EE (17.20%) in compared to high crude protein (T_2) (15.40%) because of the price of protein source. We found that significant differences in the most economic traits (Table 3 and Figures 1 and 2). Data presented in Table (3) showed that no significant differences in the price weaning litter (PWL) and price of body weight gain (PBWG). Total feed cost (TFC) in T_1 had a positive difference in compared to T_2. Net profit (NP) and net revenue (NR) which is considered a positive indicator that T_1 better than T_2 economically (Table 3). T_1 showed significant differences in economic efficiency (EE) which a good evidence for the high benefits occurred than T_2. Marginal cost to produce 1 kg of meat was reduced by 4.00 LE (7.69%) in rabbits group T_1 compared with T_2 (Fig. 1) and total cost was reduced 5460 LE for produced one ton of meat rabbits in T_1 compared with T_2 (Fig. 2).

Results agreed with Abo El-Maaty *et al.* (2023) who found that net profit, net revenue and relative economic efficiency were the highest when the dietary crude protein level was only 15% with multi enzymes supplementation compared with that 17% crude protein in control group. Sara (2021) obtained that final weight of rabbit was recovered and feed conversion ratio was improved by feed restriction. She concluded that feed restriction at levels of 30 or 40% during the first two weeks after weaning had beneficial effects on rabbit growth performance, improved feed conversion and economic efficiency. Birolo *et al.*, (2016) reported that restriction program (93% of *ad libitum*) during the first period improved rabbit health status in the fattening sector without negative effects on growth performance. The EE can be improved with decreasing feeding cost through using strategy of feed restriction which gave a

Table 3. Economic efficiency of NZW growing rabbits fed two protein levels

Items	T_1	T_2	SEM	Sig.
live body weight, g (A)	2161.6[b]	2221.9[a]	102.6	*
body weight price, L.E. /kg (B)	60.00	60.00	--	--
Net profit, L.E./rabbit (C)*	129.69[b]	133.33[a]	11.6	*
Total feed intake, kg (D) /5 weeks	4.38[a]	4.26[b]	0.9	*
Price of kg feed, L.E. (E)	13.80	15.72	--	--
Feed intake cost, L.E. (F)*	60.44[b]	66.98[a]	5.7	*
Weaned rabbits cost, L.E. (J)	50	50	--	--
Total cost, L.E. (H)*	110.44[b]	116.98[a]	9.4	*
Net revenue L.E. (I)*	19.25[a]	16.35[b]	1.8	*
Economic efficiency (G)*	17.43[a]	13.98[b]	4.8	*

[a,b] Means in the same row with the same letters are not significantly different($P \leq 0.05$)

SEM: Mean standard error NS: Non-significant, *: ($P \leq 0.05$) and **: ($P \leq 0.01$).

*calculations included period from 35 to 70 day-old, fixed cost = Price of weaning live rabbit + care + electricity + vaccination ….ect according to price in January 2023.

** C= A×B, F= D×E, H= F+J, I= C-H, G= I/H×100.

beneficial effect of feeding utilization and weight gain (Sara, 2021). Birolo *et al.* (2017) found that growth rate of rabbits did not affect by rabbits exposed to feed restriction. Gidenne *et al.,* (2003) observed that feed restriction for rabbits caused to an improvement in weight gain and marketing weight. Tumova *et al.*, (2003) demonstrated that FBW of rabbits did not affect by feed restriction.

Sara (2021) found that EE values were significantly high when feed restricted by 40% compared with control group. Romero *et al.* (2010) observed that rabbits exposed to feed restriction (fed 8 hours daily at 2 weeks after weaning) had low mortality rate because of feed restriction reduced bloated abdomen, relatively low body weight, diarrhea. Oliveira *et al.* (2012) found that feed restriction had best EE of growing rabbit compared with the control group. Also, Gidenne *et al.* (2003) reported that weaning rabbits fed restricted diets reduced feeding cost and decreased the health risk which leads to the beneficial effect on EE.

Amer and Fox (1992) derive economic weights from marginal costs curves. Marginal economic values have been estimated predominantly using a profit function developed by Armero and Blasco (1992) and adapted for specific conditions (Cartuche *et al.,* 2014).

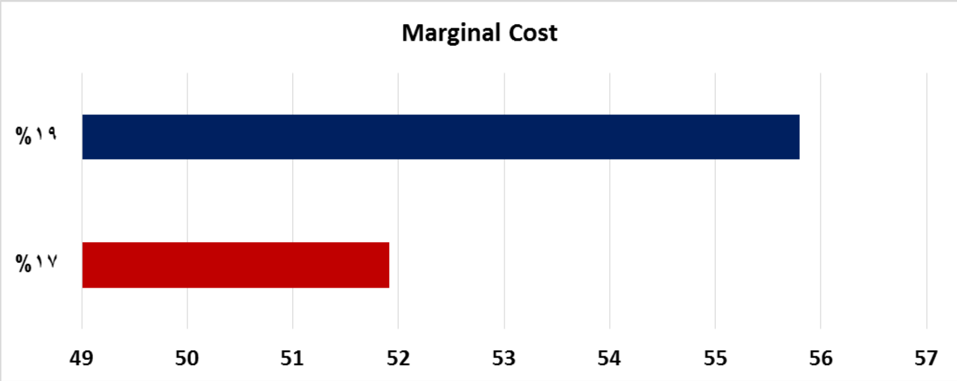

Figure (1): Marginal cost for producing 1 kg of NZW growing rabbits meat fed two protein levels

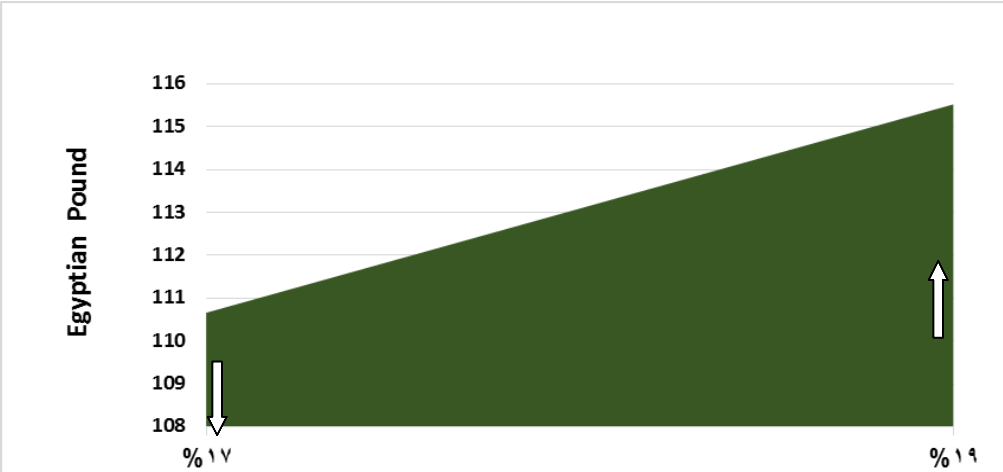

Figure (2): Saving money for producing 1 ton of NZW growing rabbit's meat fed two protein levels

***Conclusively*,** from these results it could be concluded that using 19% CP in growing rabbits diet improved productive performance but 17% CP achieve good economic efficiency.

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REFERENCES

Abo El-Maaty, M. Eman; **Abdel- Azeem, F.; El-Sawy M.A. and El-Wardany I.H. (2023).** Physiological response of weaning rabbits to dietary supplementation of probiotics**.** M.Sc., Fac. Agric., Ain Shams Univ.**,** Egypt

Amer, P.R. and Fox, G.C. (1992). Estimation of economic weights in genetic improvement using neoclassical production theory: an alternative to rescaling. *Anim. Prod.*, 54: 341-350.

Armero, Q. and Blasco, A. (1992). Economic weight for rabbit selection indices. *Journal of Applied Rabbit Research*, 15: 637–642.

Berchiche, M.; Lebas, F. and Ouhayoun, J.; (1995). Utilization of field beans by growing rabbits. 2. Effects of various plant supplementations. *World Rabbit Science*, 3 (2): 63-67.

Birolo, M.; Trocino, A.; Tazzoli, M. and Xiccato, G. (2017). Effect of feed restriction and feeding plans on performance, slaughter traits and body composition of growing rabbits. *World Rabbit Sci*., 25: 113-122.

Birolo, M.; Trocino, A.; Zuffellato, A. and Xiccato, G. (2016). Effect of feed restriction programs and slaughter age on digestive efficiency, growth performance and body composition of growing rabbits. *Anim. Feed Sci., Technol*., 222: 194-203.

Birolo, M.; Xiccato, G.; Bordignon, F.; Dabbou, S.; Zuffellato, A. and Trocino A. (2022). Growth Performance, Digestive Efficiency, and Meat Quality of Two Commercial Crossbred Rabbits Fed Diets Differing in Energy and Protein Levels. *Animal*, 12 (18): 2427-2433. https://doi.org/10.3390/ani12182427.

Caraban, O.R.; Villamide, M.J.; Garcia, J.; Nicodemus, N.; Llorente, A.; Chamorro, S.; Menoyo, D.; Garcia-Rebollar, P.; Garcia-Ruiz, A.I. and De Blas, J.C. (2009). New concepts and objectives for protein-amino acid nutrition in rabbits: a review. *World Rabbit Science*, 17: 1–14.

Cartuche, L.; Pascual, M.; Gomez, E.A. and Blasco, A. (2014). Economic weights in rabbit meat production. World Rabbit Science 22: 165–177.

De Blas, C. and Mateos, G. G., (2010). *Feed Formulation*. In: Nutrition of the rabbit - 2nd edition. de Blas, C.; Wiseman, J. (Eds). CAB International, UK.

Duncan, D. B. (1955). Multiple range and multiple F tests. *Biometrics*, 11:1–42.

El-Speiy, M.E.; K.I. Kamel; Tag El-Din A.E. and Abd-Hamid A.E. and EL-Kamhawey A. (2015). Effect of feed restriction on productive performance, carcass yield, blood pictures and relative organ weights of growing rabbits. *Egypt. Poult. Sci*., 35 (l l): 439-454.

Gidenne, T.; Feugier, A.; Jehl, N.; Arveux, P.; Boisot, P.; Briens, C.; Corrent, E.; Fortune, H.; Montessuy, S. and Verdelhan, S. (2003). Un rationnement alimentaire quantitatif postsevrage permet de réduire la fréquence des diarrhées, sans degradation importante des performances de croissance: résultats d'une étude multi-site. In: Proc. 10èmes *Journ. Rech. Cunicole, Paris,* France: 29–32.

Hemid, A.; Abdel-Azeem, F.; Afifi, M., and El-Sanhoury, M. (2015). Effect of different dietary starch and protein levels on productive performance of growing rabbits. *Egyptian Journal of Nutrition and Feeds*, 18: 247– 262.

Lang, J. (1981). The nutrition of the commercial rabbit Physiology, digestibility and nutrient requirements. *Nutr. Abstr. Rev*. 51 (2):197-225.

Lei, Q.X.; Li F.C. and Jiao H.C. (2004). Effects of Dietary Crude Protein on Growth Performance, Nutrient Utilization, Immunity Index and Protease Activity in Weaner to 2 Month-old New Zealand Rabbits. *Asian-Aust. J. Anim. Sci*., 17 (10): 1447-1451.

NRC, (1977). *National Research Council*: Nutrient Requirements of Rabbits, 2nd Revised Edition. National Academy of Sciences, Washington, DC. USA.

Oliveira, M.C.; Silva, R.P.; Araujo, L.S.; Silva, V.R.; Bento, E.A. and Silva, D.M. (2012). Effect of feed restriction on performance of growing rabbits. *Braz. J. Anim. Sci*., 41: 1463- 1467.

Omole, T.A. (1982). The effect of dietary protein on growth and reproduction performance in rabbits. *J. of Appl. Rabbit Res*., 5 (3):83-88.

Romero, C.; Cuesta, S.; Astillero, J. R.; Nicodemus, N. and De Blas, C. (2010). Effect of early feed restriction on performance and health status in growing rabbits slaughtered at 2 kg live weight. *World Rabbit Sci*., 18: 211 – 218.

Ros-Baró, M.; Casas-Agustench, P.; Díaz-Rizzolo, D.A.; Batlle-Bayer, L.; Adrià-Acosta, F.; Aguilar-Martínez, A.; Medina, F.X.; Pujolà, M. and Bach-Faig, A. (2022). Edible Insect Consumption for Human and Planetary Health: A Systematic Review. *Int. J. Environ. Res. Public* Health, 19: 11653.

Sara Khalil Sherif (2021). Effect of feed restriction regimen on productive performance and economical efficiency of weaning NZW rabbits. Egypt. *Poult. Sci*., 41 (3): 565-578.

SAS (2002). SAS/STAT User's guide statistics. SAS institute INC., Cary. NC, USA.

Sendcor, G. W. and Cochran, W. G. (1982). *Statistical Methods* **2nd** Edition. Lowa University., Press Ames, Iowa,USA

Tang, L.M. (1987). Effects of dietary energy and protein on production performances of growing rabbits. *Chinese J. of Rabbit Farming*, 6 (1):21-23.

Tumova, E.; Skrivanova, V. and Skeivan, M. (2003). Effect of restricted feeding time and quantitative restriction in growing rabbits. *Arch. Geflugelkde*, 67: 182-190.

Wang, L.; Ye, X. and Zhao, T. (2019). The physiological roles of autophagy in the mammalian life cycle. *Biol. Rev*., 94: 503–516.

Wang, S.C. (1999). The effect of different nutrient levels on growth performance of meat rabbits. *Chinese J. of Rabbit Farming*, 6 (1):20-22.

Wang, Y.X. (1991). The study of protein requirement in growing meat rabbits. *J. of Shandong Agricultural University*, 6 (2):137-145.

Xiccato, G.; Trocino, A.; Majolini, D.; Fragkiadakis, M. and Tazzoli M.(2011). Effect of decreasing dietary protein level and replacing starch with soluble fibre on digestive physiology and performance of growing rabbits. *Animal*, 5: 1179–1187.

Xu, L.D. (1982). The nutrition and diets. *Feed and Animal* , 3:22-25.

الكفاءة الإنتاجية والإقتصادية للأرانب النامية المغذاة على نسبتين من البروتين الخام

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أستخدم فى هذة التجربة عدد ٨٠ ذكر أرنب مفطوم عمر ٥ أسابيع بمتوسط وزن ٨٢٣,١٧ ± ١١,١٣ جم من سلالة النيوزيلاندى الأبيض، بهدف دراسة تأثير نسبة البروتين الخام فى العليقى على الإنتاجية والكفاءة الإقتصادية للأرانب النامية، حيث تم توزيعهم عشوائيا على مجموعتين (٤٠ بكل معامله) حيث تلقت المجموعة الأولى عليقة تحتوى على ١٧% بروتين خام (T_1) مقابل ١٩% للمجموعة الثانية (T_2). تم تقدير وزن الجسم الإبتدائى ثم أسبوعيا حتى عمر ١٠ أسابيع وكمية العلف المأكول والزيادة المكتسبة فى وزن الجسم ومعدل التحويل الغذائى كما تم عمل تقييم إقتصادى فى نهاية التجربة.

وقد أوضحت النتائج مايلى:

- زيادة نسبة البروتين الخام فى عليقة الأرانب النامية إلى ١٩% (T_2) كان لها تأثير دافع لأداء النمو متمثلا فى زيادة وزن الجسم النهائى مقارنة بالمجموعة الأولى التى تم تغذيتها على عليقة تحتوى ١٧% بروتين خام.
- المجموعة الثانية (T_2) تفوقت معنويا على مستوى ٠.٠٥% فى متوسط الوزن اليومى المكتسب على المجموعة الأولى (T_1).
- إنخفضت كمية الغذاء المأكول يوميا فى المجموعة الثانية (T_2) مقارنة بالمجموعة الأولى (T_1) مع إنخفاض معدل التحويل الغذائى (FCR).
- لوحظ تحسن معنوى فى دليل الكفاءة (PI) بالمجموعة الثانية (T_2) مقابل المجموعة الأولى (T_1).
- إنخفضت تكلفة التغذية معنويا على مستوى ٠.٠٥% بالمجموعة الأولى (T_1) مقابل المجموعة الثانية (T_2).
- تحسنت معنويا على مستوى ٠.٠٥% الصفات الإقتصادية متمثلة فى العائد الكلى والعائد الصافى والكفاءة الإقتصادية بالمجموعة الأولى (T_1) مقارنة بالمجموعة الثانية (T_2).

التوصية: تخلص الدراسة إلى أن عليقة الأرانب النامية المنخفضة البروتين ١٧% كافية لتغطية احتياجات اللارانب النامية بينما، العلائق التى تحتوى على نسبة بروتين خام ١٩% لها تأثير إيجابي على كفاءة النمو الا انها خفضت الكفاءة الاقتصادية.