EFFECTS OF FEEDING LOW-PROTEIN GROWER DIETS ON PERFORMANCE, CARCASS CHARACTERISTICS AND ECONOMIC EFFICIENCY OF BROILER CHICKENS

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SUMMARY

A total number of 120 unsexed one-day old of Cobb 500 broiler chicks were distributed into 4 treatments (30 birds each), used for evaluated the grower diets contain different levels of protein, on growth performance, carcass characteristics, and economic efficiency. The experiment lasted from one to 42day-old and contained 4 treatments diets (starter and grower) that T1(100-100); contains 100% protein requirements of the strain according to the breed manual at starter and grower period, T2(100-95%), T3(100-90%), and T4(100-85%). Results of These treatments showed that, feeding 100%, 95% and 90% protein requirements were higher insignificant records (LBW) and (DWG) than feeding 85% of protein requirement after 6 weeks from hatching. Feed consumption and Feed conversion ratio during overall six weeks from hatching until marketing weight was non-significant different among all treatments. Concerning carcass traits, Treatments T1 and T2 had higher ($P<0.05$) values of dressing percent than all other treatments. Decreasing dietary CP generally tended to increase the relative weights of the giblets, although such increases were not significant. The economic study indicated that birds fed on T2, and T3 levels of protein diets treatments were the most profitable diet among experimental diets. These results are due to feed intake and average body weight gain data which reflect on net return/bird. It is mean that decreasing the gap level of protein from starter period to grower period lead to positive effects on most of parameters which estimate the performance and production which reflect on economic efficiency of broiler chicks' strategies production

Keywords: *Low protein, performance, carcass characteristics, economic efficiency*

INTRODUCTION

Nutrient management is of major concern for today's modern poultry enterprise because feed represents the greatest single expenditure associated with poultry production. Major emphasis is given to precision feeding to reduce cost of feeding and maximize economic efficiency of poultry farming. While formulating a broiler's diet, the importance is given for utilizing the correct amount of balanced dietary protein and amino acids (AA) because it is one of the major cost components of the poultry diets second to energy and has major effect on growth performance.

Zain Ul Abiden *et al. (*2019) found that CP of broiler diets can be replaced by synthetic amino acids up to 17 in start diet and 15% in finisher diet, without changing on daily weight gain of broilers.

Ospina-Rojas *et al.* (2014), Belloir *et al.* (2017) and Shaoa *et al.* (2017) reported that decreasing dietary CP levels from 19% to 15% had no significantly effect on body weight and daily weight gain when adding limiting synthetic amino acids. In addition to, Aletor *et al.* (2000) who demonstrated that decreasing of CP diets from 225 to 153g/ kg had no significant effect on chicks' body weight gain. Moreover, the protein was an important factor revealed a feasibility of protein reduction with limiting supplementation of amino acids, whilst, protein reduction (1.5%) significantly reduced the body weight gain during pre-starter and on cumulative basis (Kumar *et al.*, 2016). Furthermore, broilers fed diets containing less than 18.12% protein reduce body weight gain by 4.6% during grower period and by 5.6% during overall period (Rezaei *et al.,* 2004).

On the other hand, broilers performance at market age showed that weight gain was not significantly affected by CP regimens (Oyedeji *et al.*, 2005). Sequentially**,** Chicks fed the three low-CP diets had no differences ($P>0.05$) in growth rate. However, chicks fed any of the three low-CP diets detected less

weight gain, less utilized the feed efficiently than chicks fed the control diets found by Bregendahl *et al.* (2002). While Shao *et al.* (2017) reported that the levels of dietary CP had no significant effect on feed conversion ratio and mortality. Furthermore, throughout the trial, there were no differences in feed conversion ratio among treatments (Laudadio *et al.,* 2012).

On the other hand, Roy *et al.* (2010) reported that different levels of dietary protein hadn't differ significantly ($p>0.05$) among groups for dressing percentage, giblet weight in male, female and mixed sex. Also, the abdominal fat of male and mixed sex was almost similar in all dietary treatments, and the difference was non-significant ($p>0.05$).

Srilatha *et al.* (2016) illustrated that, in pre-starter, starter and finisher phases, the carcass characteristics were not affected by the change of level CP diets, that the lower levels of CP (21, 19 and 16.5% CP, respectively) and amino acids used at various phases are adequate for optimum ready to cook and breast yields. However, fat deposition in abdominal area significantly increased in chicken fed low level CP diet either all through 1 to 42 d of age or the lower levels of CP during starter and finisher phases compared to those fed higher levels of CP during all three phases. Increased fat deposition could be due to wider C/P ratio in low protein diets compared to the high CP diets**.**

The aim of experiment was to evaluate the effects of reduction of crude protein in grower diets on growth performance, carcass characteristics, and economic efficiency in 42-day-old.

MATERIALS AND METHODS

One hundred and twenty chicks one - day old of Cobb 500 broiler chicks were obtained from commercial hatchery (Ismailia governorate), which randomly distributed into four treatments.

In this experiment, the chicks were in the period of (0-3 weeks) fed starter diet (100% of protein requirements and 4 grower diets (100, 95, 90, and 85 % of protein requirements according to the guidebook of Cobb 500 broilers) in the period of (4-6 weeks). Dietary treatments were as follows;

T1: Birds fed diet (100-100) contains 100% of protein requirements according to the guidebook of Cobb 500 broilers at starter and grower period.

T2: Birds fed diet (100-95) contains 100% and 95% of protein requirements at starter and grower periods.

T3: Birds fed diet (100-90) contains 100% of and 90% of protein requirements at starter and grower periods.

T4: Birds fed diet (100-85) contains 100% and 85% of protein requirements starter and grower periods.

The composition and calculated analysis of these experimental diets were presented in Table (1). All diets were formulated by using linear programming to be iso-caloric and contain the tested levels of crude protein during the experiment period. Feed was offered ad-libitum in mash form according to experimental diets in stainless steel feeders for each pen. Fresh water was accessible all the time by automatic nipple drinkers. The experiment lasted at 6 wks of age. Live body weight (g), daily weight gain (g), daily feed consumption (g/d) and feed conversion ratio (g feed/ g gain) were recorded weekly and presented herein (0-3 wks), (4-6 wks) and (0-6 wks) of age. At the end of experiment (6 wks) old, six birds were randomly taken from each treatment group and slaughtered. The percentages of carcass, liver, heart, gizzard, giblets and abdominal fats were estimated as carcass characteristics. The economic efficiency of broiler chicks production was also, calculated. The price of experimental diet and price of kg sold live birds according to the price of local market at the time of the experiments, 2018.

Data that were collected in the study were statistically analyzed using the general linear models (GLM) of **SAS, (2005),** was used one-way analysis of variance. Significant differences among means were achieved using the Duncan`s Multiple Range test **Duncan (1955)**. The level of statistical significance was set at ($P< 0.05$). The following statistical model was applied:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where: Y_{ij} = observation of the parameter measured.

μ = overall mean. T_i = the effect of treatment e_{ij} = random error effect.

Table (1): Composition and calculated analysis of experimental diets

Ingredients%	Starter	Grower			
	100%	100%	95%	90%	85%
Yellow corn	56.68	64.00	65.93	67.92	70.20
Soybean meal(44%CP)	31.15	25.13	24.76	23.85	21.74
Corn gluten meal (60% CP)	5.60	4.10	2.50	1.35	1.00
Vegetable Oil	2.00	2.50	2.50	2.50	2.50
Ca Carbonate	1.60	1.47	1.47	1.47	1.48
Mono Ca Ph	1.85	1.65	1.63	1.64	1.66
Salt (NaCl)	0.30	0.30	0.30	0.30	0.30
Premix*	0.30	0.30	0.30	0.30	0.30
HCl-Lysine	0.28	0.31	0.33	0.36	0.43
DL- Methionine	0.24	0.24	0.28	0.31	0.39
Total	100	100	100	100	100
Price L.E /Ton	5680	5420	5280	5170	5140
Calculated analysis					
CP %	22	19.04	18.05	17.1	16.15
ME (Kcal/Kg)	2999	3104	3101	3104	3120
Calcium %	1.01	0.91	0.9	0.9	0.91
Available ph %	0.51	0.46	0.45	0.45	0.45
Lysine%	1.32	1.19	1.19	1.19	1.21
Methionine %	0.62	0.57	0.59	0.6	0.61
Meth. + Cys. %	0.983	0.896	0.896	0.892	0.892
C/P Ratio	136	163	172	181	192

** The premix contains: Vitamins: A: 12000000 IU; Vit. D3 2000000 IU; E: 10000 mg; K_3: 2000 mg; B_1:1000 mg; B_2: 5000 mg; B_6:1500 mg; B_{12}: 10 mg; Biotin: 50 mg; Coline chloride: 250000 mg; Pantothenic acid: 10000 mg; Nicotinic acid: 30000 mg; Folic acid: 1000 mg; Minerals: Mn: 60000 mg; Zn: 50000 mg; Fe: 30000 mg; Cu: 10000 mg; I: 1000 mg; Se: 100 mg and Co: 100 mg.*

RESULTS AND DISCUSSION

Effect of feeding low-protein grower diets on productive performance of broiler chickens:

Live body weight (LBW) and daily weight gain (DWG):

Live body weight (LBW) and daily weight gain (DWG) were presented in Table (2). Broilers fed 100%, and 95% of protein requirements were insignificant higher in LBW than those fed 90% and 85% of protein requirement at 6 weeks of age. However, at 6 weeks of age, LBW recorded the highest values for birds fed T1 and T2 birds with insignificant different than T4 followed by T3, the values were 1927.0, 1914.4, 1809.5 and 1885.2g respectively.

Table (2): Effects of feeding low- protein grower diets on live body weight (LBW) and daily weight gain (DWG) of broiler chickens.

Items	Dietary Treatments				Sig.
	T1 (100/100)	T2 (100/95)	T3 (100/90)	T4 (100/85)	
	Live body weight (g)				
3 wks	647.58				
6 wks	1927.0	1914.4	1885.2	1809.5	NS
	(100.00)	**(99.35)#**	**(97.83)#**	**(93.90)#**	
	Daily weight gain (g/d)				
0-3 wks	28.73				
3-6 wks	61.88^{a}	60.09^{ab}	59.07^{abc}	54.46^{bc}	*
0-6 wks	44.83	44.51	43.83	42.04	NS
	(100.00)	**(99.29)#**	**(97.77)#**	**(93.78)#**	

$^{a, b,c}$ Means within the same row with different superscripts are significantly different. SEM = Standard error of means.

*Sig. = Significance, * (P≤0.05). NS = Non Significant.*
 # Relative to control

Overall period (0-6wks), daily weight gain increased in broiler fed T1-2, then T3-4 through both of starter and grower period, the values were 44.83, 44.51 and 43.83, 42.04g respectively. These results disagree with those obtained by Rezaei *et al.* (2004) who found that diet containing less than 18.12% protein decreased weight gain in grower chicken by 4.6 %. On the other hand, birds fed the recommended protein levels and had heavier final BW resulted of high body weight gain compared with those fed the low-protein diets. So, the NRC recommended levels of dietary protein are necessary for optimal performance, even in tropical conditions (Houshmand *et al*., 2012). Kriseldi *et al.* (2018), Shaoa *et al.* (2017), Belloir *et al.* (2017) and Ospina-Rojas *et al.* (2014) reported that decreasing dietary CP levels in broiler diets had no significant effect neither on body weight nor daily weight gain, when adding limiting synthetic amino acids.

Daily feed consumption (DFC) and feed conversion ratio (FCR):

Data in Table (3) illustrated that adding protein requirement with 85% allowance had lower insignificant records of feed consumption than those received 100% of protein requirement at 3-6 wks of age. These results are somewhat incompatible with those of Kamran *et al.* (2008) who found that feed intake was linearly increased with reduced CP and ME diets during grower period. While, overall, six weeks, there was no significant difference in daily feed consumption among all treatments. These agree with results of Liu *et al.* (2017) that found, when CP level decreased from 22.5% to 20.5%, there were no effects on feed consumption during 1 to 21 d of age. While, decreasing dietary CP below a minimum level, even with maintained EAA levels, retarded feed intake (Namroud *et al*., 2008).

Table (3): Effects of feeding low- protein grower diets on daily feed consumption and feed conversion ratio of broiler chickens.

Items	Dietary Treatments				Sig.
	T1 (100/100)	T2 (100/95)	T3 (100/90)	T4 (100/85)	
Daily feed consumption (g/d)					
0-3 wks		39.108			
3-6 wks	115.2	109.6	110.9	108.6	NS
0-6 wks	77.27	74.24	75.04	73.89	NS
	(100)	**(96.08)#**	**(97.11)#**	**(95.63)#**	
Feed conversion ratio (g feed/ g gain)					
0-3 wks		1.36			
3-6 wks	1.87	1.82	1.88	1.81	N.S
0-6 wks	1.73	1.67	1.71	1.76	N.S
	(100.00)	**(96.53)#**	**(98.84)#**	**(101.73)#**	

a, b Means within the same row with different superscripts are significantly different. SEM = Standard error of means.
*Sig. = Significance, * (P≤0.05). NS = Non Significant.*
 # Relative to control

Feed conversion ratio was demonstrated in Table (3). During 3-6 weeks of age, broilers received ration containing 90% of protein requirement had higher feed conversion ratio than broilers received ration content of 100%, 95% and 85% of protein requirement. On the other hand, feed conversion ratio during period and overall, six weeks from hatching until marketing weight was non-significant different among all treatments. It's clear that treatments T4 and T1 were higher values than those others that may be due to results of daily feed intake and daily weight gain.

This finding may be due to results of feed intake and body weight gain moreover; birds utilize dietary with highly efficient ratio to cover their requirements. These results agree with finding of Namroud *et al*. (2008) who reported that when chicks were fed below a minimum allowance level of dietary CP, Feed Conversion Ratio (FCR) was increased. Also, Belloir *et al.* (2017) found that reducing the dietary CP content from 19% to 15% was significantly higher feed conversion ratio in the 16% and 15% CP diets compared with the other diets.

Furthermore, Kriseldi *et al.* (2018) found that reducing dietary CP percentage from 25.8 to below 23.2% CP with keeping adequate essential amino acids concentrations increased feed conversion ratio compared with feeding the control diet from 1 to 17 day of age. In contrast, supplementation of amino

acids beyond to decrease CP content increased conversion ratio of broilers. This may be due to reduce of growth performance of birds during this period of age.

Effect of feeding low- protein grower diets on Carcass characteristics of broiler chicks:

Carcass yields were listed in Table (4). Treatments T1 (74.38%) and T2 (75.23%) had higher significant (P<0.05) values of dressing percentage than all other treatments. These results are in disagreement with **Shaoa *et al*. (2017)** that found there was no effect of the dietary CP levels on the dressing percentage. Liver and Giblet percentages were higher insignificant records in broilers of T2-4 than those of T1 in both. Decreasing dietary CP generally tended to increase the relative weights of the liver and giblets, although such increases were not significant (P>0.05) (Namroud *et al*., 2008 and Aletor *et al*., 2000).

Table (4): Effects of feeding low-protein grower diets on carcass yield of broiler chickens.

Items	Dietary Treatments				Sig.
	T1 (100/100)	T2 (100/95)	T3 (100/90)	T4 (100/85)	
Dressing %	74.38[a]	75.23[a]	71.19[b]	71.12[b]	*
Liver %	3.04	3.16	3.39	3.11	NS
Gizzard %	1.69	1.85	1.96	1.88	NS
Heart%	0.59	0.60	0.60	0.65	NS
Giblet %[#]	5.56	5.76	6.08	5.79	NS
Abd. Fat %[@]	2.10[ab]	1.85[b]	2.96[a]	2.89[a]	*

*[a, b] Means within the same row with different superscripts are significantly different. SEM = Standard error of means. Sig. = Significance, * (P≤0.05). NS = Non Significant.*
[#]Giblets = Liver + Gizzard + Heart . [@] Abd. Fat: Abdominal fat

On the othe hand, abdominal fat percent was lower significant (P<0.05) record in broilers of T2 (1.85%) than those of T3 (2.96%) and T4 (2.89%), while T1 was in middle (2.10%). Amount of fat in abdominal area significantly increased in broiler fed small levels CP diets through 1 to 42 d of age (Srilatha *et al.,* 2016). The increase of abdominal fat% may be related to high C/P values obtained due to the reduction in CP (Belloir *et al* ., 2017). On the other hand, Shaoa *et al.* (2017) showed that there was no response of the dietary CP levels on the abdominal fat percentage.

Effect of feeding low- protein grower diets on Economic evaluation of broiler chicks:

Results of economic evaluation of broiler chicks fed different treatments diets are outlined in Table (5). It is clear that, birds fed on T2, and T3 levels of protein diets improved the percent of economic efficiency expressed as percentage of net return/feed cost and relative economic efficiency than other experimental treatments. These results due to feed intake and average weight gain data which reflect on net return/bird. These results were confirmed by Emam, (2018) that found during the period from 6 to 41 days of age, economic efficiency (EEF) values were improved for broilers fed diets lowering protein content by -2% supplemented with the allowance of Methionine and Lysine had the best economical and relative efficiency values.

Table (5): Effects of feeding low- protein grower diets on economic efficiency of broiler chickens.

Items	Dietary Treatments			
	T1 (100/100)	T2 (100/95)	T3 (100/90)	T4 (100/85)
Feed Cost / Bird (LE)	17.81	16.79	16.72	16.40
Total Cost[1] / Bird (LE)	29.81	28.79	28.72	28.40
Total Return[2] Bird (LE)	52.03	51.69	50.90	48.86
Net Return / Bird (LE)	22.22	22.90	22.19	20.46
Economic Efficiency[3]	74.56	79.52	77.26	72.05
Relative Economic Efficiency[4]	**100**	**106.65**	**103.62**	**96.64**

[1] Total cost = (feed cost + price of one-day live chicks + incidental costs); L.E.: Egyptian Pound
[2] According to the local price of Kg sold live birds was 27.00 L.E.
*[3] Economic efficiency = net return/total feed cost*100. Whereas net revenue= total return - total feed cost.*
[4] Assuming that the relative economic efficiency of control group equals 100.

CONCLUSION

In conclusion, the results of our study indicated that decreasing percent of CP in grower diets such as birds fed on T2 (95%), and T3 (90%) levels of protein diets had positive effects without any adverse effects on productive performance, and carcass traits with improving economic efficiency.

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تأثير التغذية على علائق النامي المنخفضة في البروتين على الأداء الإنتاجي وصفات الذبيحة والعائد الاقتصادى لدجاج التسمين

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استخدم في التجربة 120 كتكوت تسمين عمر يوم من سلالة (كوب 500) وزعت على 4 معاملات تجريبيه (30 كتكوت / معاملة) لدراسة تأثير المستويات المنخفضة من البروتين على علائق النامي على الأداء الإنتاجي وصفات الذبيحة والعائد الاقتصادي لدجاج اللحم واستمرت التجربة 42 يوم وكانت المعاملات كالاتي

- T1 (100 – 100%) احتوت العلائق على المستوي القياسي للبروتين
- T2 (100 – 95%)
- T3 (100 – 90%)
- T4 (100 – 85%)

احتوت العلائق على 100% في البادي و100%, 95% ,90% , 85% من احتياجات السلالة من البروتين في علائق النامي على التوالي.

وتتلخص النتائج في التالي:

- الأداء الإنتاجي: تغذية كتاكيت التسمين في فترة النامي على علائق تحتوي على T1 (100%) , T2 (95%) , T3 (90%) من البروتين وسجلت اعلى مستوى غير معنوي في الوزن الحى والوزن المكتسب بالمقارنة بتلك التي تغذت على عليقة T4 (85%).
- صفات الذبيحة: سجلت دجاج اللحم المغداة على معاملات T1 وT2 اعلى نسبة للذبيحة معويا بالمقارنة بالمعاملات الأخرى وتنخفض %للبروتين في علائق النامي يزيد من نسبة المئوية للحوائج المأكولة بصورة غير معنوية
- العائد الاقتصادي: أفضل عائد اقتصادي سجلت الطيور المغداة على T2 وT3 بالمقارنة بالمعاملات الأخرى

الخلاصة:

تخفيض مستوى البروتين في علائق النامي بمعدل 95% , 90% من احتياجات السلالة يحسن العائد الاقتصادي بدون التأثير على الأداء الإنتاجي لدجاج اللحم.