EFFECTS OF FEEDING LOW-PROTEIN GROWER DIETS ON BODY COMPOSITION, NITROGEN EXCRETION AND BLOOD PLASMA PARAMETERS OF BROILER CHICKENS

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SUMMARY

One day old, 120 mixed sex (Cobb 500) broiler chicks were used to evaluate the effects of protein levels in grower diets (4 – 6 wks) of age on carcass parts, breast chemical composition, nitrogen retention and excretion and some blood parameters. Broiler chicks were fed a common starter diet from (0 – 3 wks) of age and from (4 to 6 wks) of age broiler were attributed to the 4 grower experimental treatments with 3 replicates (10 broilers each). The experimental design consisted in a high CP grower diet (T1; 100%, CP = 19%) and those low CP diets (T2, 95% =18, T3, 90% = 17% and T4, 85% = 16%).

The results indicated that:

1. Broiler received diet containing 100% of protein required in growing period (T1) had significantly highest breast muscles and drumstick percentages than those in (T4) 85% CP.
2. Chemical composition of breast meat (OM, ASH and E.E%) showed significant figures when broiler chickens fed different dietary treatments.
3. Broiler chickens fed (T4, 85% CP) grower diet retained significantly nitrogen and lower excretion value than Those T1, T2 and T3.
4. All blood plasma parameters were in the normal range except glucose levels which means that no negative effects on decreasing level of protein requirements during growing period on broilers health.

Based on the results obtained it can be concluded that feeding broiler chickens lower crude protein diets during the grower period significantly affected carcass parts, chemical composition of breast meat, nitrogen retention and excretion.

Keywords: Low protein, body composition, nitrogen extraction, blood plasma, broiler chicken

INTRODUCTION

Feed considers the highest cost of poultry production, about 95 % of total feed cost is used to meet energy and protein (amino acid) requirements. Improvement of poultry production is the important activities that can be done with enhancing this important issue (Madia, 2005).

Two main nutritional ways may be helpful to decrease N losses in poultry production. The primary is to feed dietary protein (amino acid) as possible to be closing for poultry requirements. The second is that the dietary additives as probiotics, enzymes and organic acid for poultry to enhance N utilization. (Ayanrinde *et al.,* 2014).

However, the Nitrogen excreted in manure was estimated relative to dietary intake that is 65–70% for poultry or swine (Han *et al.*, 2001). Lin *et al.* (2017) reported that nitrogen excretion may be decreased by feed animals with accurate way according to their protein/amino acid requirements. In practice, dietary crude protein (CP) levels are always higher than those animals actually received their requirement. So, based on the ideal protein concept, it is possible to low levels of CP in animal diets and received requirements of the amino acid by supplementation with synthetic amino acids. Adding synthetic amino acids to diets with low-CP resulted in reducing N excretion in poultry without any bad effects on the growth performance of animals. However, Carter and Kim (2013) explained that excretion excess N by poultry arises that mainly from dietary amino acids and may effect on volatilization of ammonia which increased from animal production systems subsequent air quality can affected. In addition to, Nahm (2007) confirmed

that by losses of nitrogen are mainly due to catabolism of amino acid and metabolism of muscle which resulted in protein turnover. Corzo *et al.* (2009) fount that decreasing CP in starter and finisher phasesin the broiler diets enhanced N percentage retained.

Increasing the number of feeding phases in poultry seems benefits. In the finisher broilers, increasing growth performance was observed by depressing dietary lysine, amino acid with sulfur and threonine contents under feeding program. In the finisher broilers, excretion of nitrogen was decreased (Pope *et al.* 2004). As study by Belloir *et al. (*2017) who found that when dietary CP content was decreased, the efficiency of retention for nitrogen enhanced from +3.2% to +3.6%/CP percentage point. In addition to, decreasing CP content by less than 2 percentage units of broiler diets or by 13% units in nitrogen intake led to more than an 18% of litter N content was depressed (Ferguson et al., 1998). On the other hand, The protein factor significantly decreased the carcass yields, breast and thigh when reducing 1.5% protein diet compared to recomended protein group. (Kumar *et al.* 2016). Breast and leg yields were not influenced (P>0.10) by levels of dietary CP. no change was observed in body composition from dietary CP concentration (Oliveira *et al.* 2013).

Belloir *et al.* (2017) found that dietary CP didn't affect on the breast meat yield. While percentage of abdominal fat was enhanced as a result of decreasing of CP content in the diet with greatest values for diets 16% and 15% CP. Thus, The dressing percentage, breast muscle percentage, eviscerated yield, thigh muscle percentage and abdominal fat percentage was not affected by levels of the dietary CP as reported by Shaoa *et al.* (2017). Moreover, At the pre-starter and finisher phases, the total protein levels in the blood plasma of chicks raised linearly with improving diets protein content. However, reducing level blood plasma albumin by decreasing the level of protein in the diet. (Hernandez *et al.* 2012). Moreover, the decrease in the total protein levels and albumin in blood plasma could be related with a deficit content of amino acids ingested by animals (Corzo *et al.* 2009).

Hernandez *et al.* (2012) found that broilers obtained the highest levels of protein resulted in lower levels of glucose in blood plasma ($P< 0.05$) might be due to increase starch consumption when the protein level of feed reduced that because diet soybean meal was replaced by cereals. Male chicks had higher glucose levels than females in the grower and finisher phases ($P< 0.05$). Also, Corzo *et al.* (2009) reported that glucose levels were affected by the type of diet in the finishing stage.

Therefore, this experiment was designed to study the effects of feeding low- protein grower diets on body composition nitrogen excretion and blood plasma parameters of broiler chickens.

MATERIALS AND METHODS

The current study was carried out at the Poultry Nutrition Farm, Poultry Production Department, Faculty of Agriculture, Ain Shams University, Shoubra El-kheima,Qalubia Governorate, and all chemical analysis were performed in the laboratories of the Poultry Production Department, Faculty of Agriculture, Ain Shams University, Shoubra El-kheima,Qalubia Governorate, Egypt. The aim of this present study was to:

- Modify Nitrogen in Broiler Manure.
- Reduce environmental pollution by Nitrogen.

In broiler diets during starter and growing period. To ensure these purposes we estimate Nitrogen retention, chemical composition of breast meat and some plasma blood parameters. The current study was composed of 120 unsex one day old Coob 500 were randomly assigned to 4 treatments of 30 chicks each in three replicates (10 chicks per replicate) the following treatments: control diets (T1): Birds fed diet (100-100%), T2: Birds fed diet (100-95%), T3: Birds fed diet (100-90%), and T4: Birds fed diet (100-85%) of protein requirements at grower (4 – 6 wks) periods. The nutrition requirements for broiler chicks were covered (Table 1). Chicks were individually weighted to the nearest gram at weekly intervals during experimental period. Feed consumption was recorded and feed conversion ratio an live body weight gain were calculated.

Carcass parts and breast chemical composition:

At the end of the experimental period (6 wks of age); six birds from each treatment were weighted and slaughtered for determination of carcass parts and breast chemical composition.

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.*

Nitrogen retention and excretion:

During the last 5 d of the experimental period, excreta samples were collected using the partial collection method and immediately stored in a freezer (-18) until the analysis for determined nitrogen retention and excreta.

Blood plasma paraments:

Individual blood samples were collected and centrifuged at 3000 RPM for 15 minutes. Plasma was stored at -20 °C until performing the biochemical analysis. All biochemical parameters of blood were calorimetrically determined using commercial diagnosing kits (produced by spectrum company, Egypt).

Statistical analysis:

Data were processed by one-way Anova analysis of variance using general linear model (GLM) procedure of **SAS (2005)** software

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

Where: Yij = observation of the parameter measured.

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

Individual effects of experimental groups were compared using Duncan (1955) multiple range test at a level equal to 0.05 or 0.01.

RESULTS AND DISCUSSION

Carcass parts%:

Data in table (2) illustrated the carcass parts percentage of broiler chicks fed successive levels of crude protein. It's clear that broilers received ration containing 100% of protein requirement in both of starter and growing period (T1) had significantly highest breast muscles and drumstick percentage than those in T4. In contrast, T1 had the lowest percentage of thigh, and wing than those in T4. Sequentially, Pectoralis major muscle had higher significant records for broiler of T1 than those others except T2. Also, Pectoralis

minor muscle had higher significant records for broiler of T1 than those in T4. This means that broilers received its adequate requirements of protein have optimal metabolism and it can utilize nutrients. These results are in harmony with results of Widyaratne and Drew (2011) who reported that, the maximum breast meat yield requires a high protein diet moreover, is not affected by ingredient digestibility. There are opposite results by Shaoa *et al.* (2017) that found there was no response of the dietary CP levels on the breast muscle %, thigh muscle %.

However, birds fed diets with high and medium CP levels had higher breast and drumstick yields percentage than did broilers fed the low-CP diet (Laudadio *et al*., 2012). Moreover, the protein depression significantly reduced the yields of carcass, breast and thigh at 1.5% protein reduction compared to normal protein group (Kumar *et al.,* 2016). These results are in disagreement with Belloir *et al.* (2017) who reported that the breast meat yield was not affected by the dietary CP.

Table (2): Effect of feeding low- protein grower diets on carcass parts percentage of broiler chicks.

Items	Dietary Treatments				Sig.
	T1 (100/100)	T2 (100/95)	T3 (100/90)	T4 (100/85)	
Drumstick weight %	10.63^{a}	9.78^{b}	9.56^{b}	9.23^{b}	*
Thigh weight %	12.93^{c}	14.20^{ab}	13.64^{abc}	13.55^{bc}	*
Pectoralis major muscle weight %#	25.20^{a}	24.85^{ab}	23.97^{bc}	20.94^{e}	*
Pectoralis minor muscle weight %@	6.79^{b}	6.69^{b}	6.77^{b}	5.22^{c}	*
Bone%	17.14^{de}	17.78^{de}	18.48^{dc}	21.63^{a}	*
Neck weight %	4.93^{abc}	5.45^{a}	4.65^{bc}	4.49^{c}	*
Wing weight %	7.77^{d}	7.63^{d}	7.98^{d}	9.05^{abc}	*
Skin%	14.51	13.62	14.95	15.89	NS

*$^{a, b,c,d,e}$Means within the same row with different superscripts are significantly different. SEM = Standard error of means. Sig. = Significance, * (P≤0.05). NS = Non Significant.*

Chemical composition of breast meat:

In Table (3), it was noticeable that T4 had significantly increased in organic matter percentage of breast meat than T1, T2 and T3. The converse results were observed in ash percent, There were insignificantly different in CP percentage of breast meat analysis among treatments. Ether extract (EE %) was significantly higher value of treatment T4 than T1; it may be related to the higher C/P ratio obtained. Whenever, decreasing levels of CP in diets cause an increase in carcass fatness (Si *et al.,* 2001).

Table (3): Effect of feeding low- protein grower diets on breast meat chemical composition of broiler chicks.

Items	Dietary Treatments				Sig.
	T1 (100/100)	T2 (100/95)	T3 (100/90)	T4 (100/85)	
OM%[1]	92.75^{bc}	92.50^{c}	92.82^{bc}	93.87^{a}	*
ASH%	7.24^{ab}	7.50^{a}	7.18^{ab}	6.12^{c}	*
CP%[2]	81.08	80.06	81.28	79.64	N.S
EE%[3]	4.38^{c}	4.72^{bc}	4.94^{bc}	5.77^{ab}	*

*$^{a, b,c}$Means within the same row with different superscripts are significantly different. SEM = Standard error of means. Sig. = Significance, * (P≤0.05). NS = Non Significant.*

1: Organic matter%. 2: Crude protein%. 3: Ether extract%.

Blood plasma parameters:

Results of blood parameter listed in Table (4) indicated that blood total protein of broiler was significantly decreased with the lowest percent of protein (T4; (100 – 85%)), whereas the highest value obtained in broiler fed (T1; (100 – 100%)). The results indicated that (100 – 100%) increased the protein metabolism and improved the growth of the chick compared with other treatments. The values of total proteins records in the blood of male chicks increased linearly (P<0.05) with increasing protein content in both pre starter and finisher phases (Hernandez *et al.*, 2012).

On the other hand, birds of T2 were significantly higher values for blood glucose than those of T4. While, other treatments had values in between for both of total protein and glucose parameters. Chickens that consumed the highest levels of protein showed lower levels of plasma glucose (P<0.05) may be due to increase intake starch in diets when protein percent of feed decreased, because soybean meal was replaced by corn (Corzo *et al.,* 2009 and Hernandez *et al.*, 2012). However, blood glucose values were un-affected by the experimental diets (Kamran *et al.*, 2010).

There were insignificant different among treatments for parameters of albumin, globulin, uric acid, creatinin, triglycerides, cholesterol, GPT and GOT. Reducing the level (%) of protein in the diets (P<0.001) decreased the blood albumin levels through pre starter, starter, and finisher phases (Hernandez *et al.*, 2012). Dietary CP level (%) had effect on plasma uric acid concentration. The highest values of plasma uric acid were obtained from broiler fed high-CP diets (Namroud *et al*., 2008). Lowering of dietary CP content (%) decreased blood plasma uric acid and increased plasma triglycerides concentration (Kamran *et al.*, 2010). The higher value of blood uric acid was observed from the highest CP diet (Darsi *et al.,* 2012). Birds fed the optimal levels of protein had less blood cholesterol than those broilers fed diets with low protein) Houshmand *et al*., 2012). All blood plasma parameters were in the normal range except glucose levels which means that no negative effects of decreasing level of protein requirements during growing period on broilers health.

Table (4): Effect of feeding low- protein grower diets on some blood plasma parameters of broiler chicks.

Items	Dietary Treatments				Sig.
	T1 (100/100)	T2 (100/95)	T3 (100/90)	T4 (100/85)	
T. protein(g/dl)	3.76	3.59	3.69	3.4	NS
Albumin(g/dl)	2.12	2.29	2.13	2.11	N.S
Globulin(g/dl)	1.64	1.30	1.55	1.31	N.S
Glucose(mg/dL)	271.3^{ab}	275.6^{a}	269.3^{ab}	258.6^{b}	*
Uric acid(mg/dL)	6.56	6.13	6.46	6.15	N.S
Creatinine(mg/dL)	0.63	0.70	0.63	0.58	N.S
Triglycerides (mg/dL)	103	104	104	105	N.S
Cholesterol (mg/dL)	125	123	124.66	125.66	N.S
GPT(U/L)	13.43	14.26	14.20	14.66	N.S
GOT(U/L)	239.6	247.3	240.3	247.3	N.S

*$^{a, b}$ Means within the same row with different superscripts are significantly different. SEM = Standard error of means. Sig. = Significance, * (P≤0.05). NS = Non Significant*

Nitrogen retention and excretion:

Percentage of nitrogen retention and execration were demonstrated in Table (5). Broiler chicks of treatments which consumed (100/85%; T4) of protein allowance during experimental periods (starter and grower) were more retained significantly nitrogen than that T1, T2 and T3 which consumed (100/100%), (100/95%) and (100/90%) of protein allowances during experimental periods; respectively. In contrast, the result of excretion illustrated that broilers of T1, T2 and T3 were higher excretion value than those of T4. This means that whenever increasing drop of protein level from starter to grower periods, broilers affected and reflect on broilers performance. Decreasing dietary CP level has no significant influence on total body protein content, while protein deposition (retention) was non-significant increased (Aletor *et al*., 2000).

Table (5): Effect of feeding low- protein grower diets on nitrogen retention and excretion of broiler chicks.

Items	Dietary Treatments				Sig.
	T1 (100/100)	T2 (100/95)	T3 (100/90)	T4 (100/85)	
Ret %	70.43^{d}	70.87^{d}	70.15^{d}	73.26^{b}	**
	(100.00)	**(100.62)$^{\#}$**	**(99.60)$^{\#}$**	**(104.02)$^{\#}$**	
Exec %	29.57^{a}	29.13^{a}	29.84^{a}	26.74^{b}	**
	100.00	**(98.51)$^{\#}$**	**(100.91)$^{\#}$**	**(90.43)$^{\#}$**	

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

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تأثير التغذية على علائق النامي المنخفضة في البروتين على تركيب الجسم والنيتروجين المحتجز وقياسات بلازما الدم لدجاج اللحم

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استخدم في التجربة 120 كتكوت تسمين عمر يوم من سلالة دجاج اللحم (كوب 500) لدراسة تأثير تخفيض مستوى البروتين في علائق النامي (4 – 6) أسابيع على أجزاء الذبيحة وتركيب لحم الصدر والنيتروجين المحتجز وبعض قياسات بلازما الدم

كتاكيت التسمين غذيت على عليقة البادئ القياسية تبعا لكتالوج السلالة من (0 – 3) أسبوع ثم وزعت على 4 معاملات / 3 مكرر من عمر (4 – 6) أسبوع وغذيت على 4 علائق نامي كالاتي

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

تتلخص النتائج المتحصل عليها فيما يلى:

- دجاج اللحم المغداة على عليقة T1 (100% من احتياجات السلالة) في عليقة النامي سجلت اعلى قيم معنوية في %لحم الصدر و% للساق بالمقارنة بتلك المغداة على عليقة T4 (85%) من احتياجات السلالة من البروتين الخام
- التركيب الكيميائي للحم الصدر (OM,ASH and E.E%) تأثر معنويا بالتغذية على المستويات المختلفة من البروتين في علائق النامي.
- دجاج اللحم المغداة على عليقة النامي T4 سجلت اعلى قيم معنوية للنيتروجين المحتجز بالمقارنة بالمعاملات الأخرى.
- قياسات بلازما الدم في المستويات الطبيعية ولا يوجد تأثير معنوي للمعاملات الغذائية فيما عدا مستويات الجلوكوز في الدم

من النتائج يمكن استنتاج ان تغذية دجاج التسمين على مستويات منخفضة من البروتين الخام في علائق النامي تؤثر معنويا على أجزاء الذبيحة والتركيب الكيميائي للحم الصدر والنيتروجين المحتجز.