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NUTRITIONAL AND ECONOMICAL IMPACT OF USING SUPER STARTER DIETS IN FEEDING BROILER CHICKENS

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SUMMARY

An experiment was conducted to study the effect of feeding recommended (23%, $Diet_1$) or high (25%, super starter, $Diet_2$) crude protein in starter diets on productive performance, carcass characteristics and economical efficiency of Hubbard broiler chickens. A total of 225, day old Hubbard broiler male chicks were randomly distributed into 5 treatments at (1-35) days of age, each with three replicates of 15 birds each. The five treatments were: T_1) Control group, chicks fed ($Diet_1$) ad-libitum the other treatments from T_2 till T_5, chicks were fed ($Diet_2$)at different quantities being 125g, 250g, 375g and 500g/chick, respectively followed by ($Diet_1$) to the end of starter period (14 days of age). During grower and finisher periods, all chicks were fed recommended diets at these phases. At the end of experiment at 35 days of age, 4 broilers chicken per treatment were slaughtered and evaluated for carcass traits. The results indicate that: Body weight, body weight gain and feed intake were linearly increased, whereas feed conversion ratio decreased as super starter diet increased, during overall period (1-35 days of age). The best values of body weight gain, feed conversion ratio, protein and energy conversion ratio were observed for chickens fed 500g super starter diet compared with other dietary treatments. In most cases differences between treatments were significant ($P \leq 0.01$). Carcass characteristics of chicks fed super starter diet, added at different levels had no effects on carcass characteristics. The best economical efficiency value were demonstrated when broiler chickens fed (500g $Diet_2$/chick) super starter diet and the values was 33.09% more when compared to that of chicks fed control diets. In conclusion, feeding broiler chickens super starter diet at level of (500g/chick) support and enhance productive performance and economical efficiency.

Keywords: *Broiler performance, carcass characteristics, super starter diet, economic efficiency.*

INTRODUCTION

Global poultry meat and egg production as well as trade with poultry products have shown a remarkable dynamic during the last 35 years. Between 1970 and 2005 poultry meat increased faster than beef and veal or pigment production Windhorst (2006). Therefore, a better understanding and updating of the nutritional requirements of broiler chickens under Egyptian conditions is needed in order to reach its potential in poultry industry.

Energy and protein are an important nutritional, representing majority of total cost of the diets and the most economically factors affecting profitability for boiler chickens (Sterling *et al*., 2005 and El-Faham*et al*., 2016a).

Increasing profitability of broiler chickens production is dependent on reducing input costs and/or increasing production output. Any reduction in feed cost/chickens or improved in feed efficiency without compromising growth rate or carcass quality can have a significant positive economic impact on broiler chickens production (Sterling *et al*., 2005).

Several experiments with broiler chicks or quails have shown that performance is adversely affected with low crude protein diets and investigated the potential reasons for decreasing performance and economic efficiency (Mosaad and Iben, 2009; Malomoand Olutade, 2013; Folorunso*et al*., 2014 and Ali, 2006). Similar results were observed by (Bregendahl*et al*., 2002; Sterling *et al*., 2005 and Waldroup*et al*. 2005) indicated that, rate and efficiency of growth is lowered and carcass composition becomes inferior in broilers fed diets in which crude protein has been lowered by more than 2.5% of the chicken requirements, even when all known nutrient requirements are supplemented such as amino acids. On the other hand, some researcher's studies had found that reducing dietary crude protein does not affect growth performance and carcass traits (Parr and Summaers, 1991, Moran and Stilborn, 1996, Saleh 2016 and El-Faham*et al*., 2016). Therefore,in the present study, an experiment was conducted to investigate the effect of feeding recommended or high crude protein in starter diets on productive performance, carcass characteristics and economicalefficiency of Hubbard broiler chickens.

MATERIALS AND METHODS

Birds and management:

This study was conducted at a private local broiler farm, Monufia governorate. A total number of 225 Hubbard broiler male chicks, day old, were randomly allotted to 5 dietary treatments (45 chicks per treatment) in 3 replicates (15 chicks/replicate). Chicks were housed in battery cages, kept under similar environmental and managerial conditions during 1-35 days of age. Feed and water were offered ad-libitum all over the experimental period.

The experimental diets:

Two starter diets were formulated to contain and (23.01% CP with 3046 kcal/kg; starter, $Deit_1$) (25.01% CP with 2918 kcal/kg; super starter, $Deit_2$) for starter phase (1-14) days of age, while during grower phase (15- 28d) chicks were fed (21.01% CP with 3159 kcal/kg, $Deit_3$) and during finisher phase (29- 35d) chick fed (19.04% CP with 3238 kcal/kg, $Deit_4$). Methionine, Lysine and mixture of vitamins and minerals were added to cover the requirement of Hubbard chicks according to NRC, 1994.

Chicks were distributed into five treatments in starter period as follows: T_1: Control group, chicks fed ($Diet_1$) ad-libitum and T_2 -T_5 groups, chicks fed 125g, 250g, 375g and 500g/ chicks ($Diet_2$) respectively followed by ($Diet_1$) to the end of starter period (14) days of age then all experimental chicks fed grower and finisher diets ($Diet_{3-4}$). Feed ingredients and chemical analysis of the diets used in this experiment are shown in Table (1).

Data collection:

Growth performance parameters:

Live body weight and feed intake of broiler chicks were recorded. While, body weight gain and feed conversion ratio were calculated. Performance index was measured according to North (1981), where production efficiency factor according to Emmert (2000).

Also, the protein conversion ratio (PCR) and energy conversion ratio (ECR) were calculated for overall period.

Carcass characteristics:

At the end of experimental period (35 days of age), four broilers chicks per treatments were randomly taken and slaughtered. Data of carcass traits were calculated as % of live body weight (Carcass% and giblets%).

Economical efficiency:

The economical efficiency for broiler chicks (meat production) was calculated according to the price of local market for feed ingredients and selling price of line broiler chickens at the time of the experimental (March/2017). Economical efficiency = the net revenue/total cost.

Statistical analysis:

Statistical analysis was conducted using the General linear Model (GLM) procedure of SAS (2004). Means were compared using Duncan’s Multiple Range Test (Duncan, 1955) and level of significance was set at minimum of ($P \leq 0.05$). The statistical model was

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

Where:

Y_{ij} = observation of the parameter measured. μ = overall mean.

T_i = effect of treatment (i : 1 to 5). e_{ij}= random error.

RESULTS AND DISCUSSION

Productive Performance:

Live Body weight (LBW) and body weight gain (BWG):

There were a significant difference ($P<0.01$) in LBW and BWG values due to experimental treatments (Table 2) Results show that the worest values of LBW and BWG had been obtained by broiler chicks fed control diet (T_1) compared with the other treatment (T_2till T_5). The explanation of that could be related to the fact that, Excess protein level in super starter (Diet$_2$) improve BWG in Comparison with the control diet (Diet$_1$) or Diet2 (super starter) was formulated to meet the optimum nutrient requirements for broiler chicks based on the recommendations of NRC (1994).

On the other hand, chicks fed 375g or 500g from Diet2 (T_4 and T_5) gave higher LBW (2155g and 2226.67g respectively). Compared to those fed lower quantity of diet$_2$ (T_2 and T_3), Being 2028.33 and 2046.67 (g) respectively and the differences failed to be significant.

In the same trend, responses of chicks fed either (375g Diet$_2$ T_4) or 500g Diet$_2$ (T_5) significantly higher BWG than those fed the two other lower levels of Diet$_2$ (T_2 and T_3) and the difference were statistically significant compared with those fed control diet (T_1). These results are agreement with those obtained by Gheisari *et al.* (2011) who reported that feeding growing quail diet contained high protein level (24%) improved body weight as compared with quail received the lower protein level (21%CP). Moreover, El- Faham *et al*. (2016a,b) and Karman *et al*. (2008), stated that live body weight and weight gain of broiler chickens was linearly decreased as dietary protein and energy decreased during experimental periods. On the other hand, these findings were in contrast with the results obtained by Saleh (2016) who reported that feeding (Cobb Avian, 48) broilers on 1% lower protein diets than the strain recommendation, at constant ME, had not adversely affected the growth performance.

In another study conducted by Abd- Elsamee (2001 and 2002) found that chicks fed low protein diets (ranged from 21 to 17% CP) supplemented with essential amino acids had similar growth rate and feed efficiency as those fed 23% CP diet. The same observation was reported by Harms and Russell (1993) on laying hens.

Feed intake (FI) and feed conversion ratio (FCR):

The obtain date show that, there were significant differences in feed intake and feed conversion ratio among treatment during whole overall period (1-35) days of age. It was obvious from (Table 2) that feed intake per bird (g) was significantly ($P<0.01$) increased by feeding (Diet$_2$), (T_2-T_5)compared with those fed control diet (T_1). The increase in feed consumption was ranged between 9.2 and 18.5%, with significant differences between treatments.

In the same order, the values of FCR indicted significant differences between birds fed 250g, 375g and 500g Diet$_2$ (T_3, T_4 and T_5), compared with those fed control (T_1) or 125g Diet$_2$(T_2). The best FCR was detected for the birds fed 500g Diet$_2$ (T_5, 1.59). On the other hand, the worst FCR were found in birds fed the control diet or 125g Diet$_2$ being the same rate 1.64, respectively.

Which could be to the highest body weight gain, since birds fed (T_5) diet were more efficient in converting their food into body weight gain compared with those fed control diets (T_1). Similar results were observed by Kamran *et al.* (2008) and El-Faham *et al.* (2016a,b) in broiler chickens and Harms and Russell (1993) in laying hens and Abdel-Azeem *et al*. (2005)in Japanese quail and Gheisari *et al.* (2011) on growing quail.

Growth rate:

Significant differences ($P<0.05$) were observed in growth rate between experimental treatments during whole experimental period (Table 2)where, feeding chicks with 375 and 500g Diet$_2$ (T_4 and T_5) showed the highest (1.93) growth rate followed by those fed 125g and 250g Diet$_2$(T_{2-3}, 1.92), while chickens fed control diet (T_1) had the lowest value being (1.91) and in most cases differences were significant.

Protein conversion ratio (PCR) and energy conversion ratio (ECR):

The results concerning the effect of dietary treatments on the PCR and ECR are shown in Table (3). The values of PCR and ECR indicated significant differences between birds fed 250g, 375g and 500g Diet$_2$, compared with those fed control T_1 or fed 125g Diet$_2$ (T_2) diets. The best values were detected for the broiler chicks fed T_5 diet. The corresponding rates were 0.33 and 5.0 respectively. On the other hand, the worst PCR and ECR values were found in birds fed control diets (being 0 and 5.36, respectively).

Performance index (PI) and productive efficiency factors (PEF):

The obtained date showed that, there were significant different in PI and PEF among various treatments (from T_1till T_5) during the studied period (1-35 days). Data in Table (3) indicated that PI and PEF values were significantly increased by increasing super starter diets (Diet$_2$) for broiler chickens (from T_2-T_5) as compared to those fed control diets (T_1). In addition, chickens fed (T_5) diets gave the highest values (139.74 and 399.26) compared to those fed control diets being 111.41 and 318.32, respectively, however, differences failed to be significant. Similar observations were reported by Awad *et al.* (2014), who reported that significant differences were observed in PI between experimental treatments due to varing ME, CP levels and duckling sex during experiment periods (2-20 wks). On the other hand, these findings are in contrast with the results obtained by Kout El-Kloub *et al*. (2010) who reported that PIU values were insignificantly decreased by increasing both ME and CP levels in Domyati duckling diets during 0-12wks, of age.

Carcass characteristics:

Table (4) shows the effect of super starter diet$_2$ on some carcass characteristics for the male chickens at the end of 35 days of age. Experimental treatments (T_{2-5}) had no significant effect on studied parameters compared with control (T_1). The corresponding values for dressed carcass percentages ranged between 64.17 and 66.22%, while giblets percentages (liver + gizzard + heart) percentages ranged between 4.10 and 4.55%. In addition, chickens fed control diets gave numerally the lowest dressed carcass% (64.17) compared to those fed different dietary treatments from T_2- T_5, being 66.22, 65.19, 65.91 and 65.49 respectively and differences among treatments were insignificant. Similar observations were reported by other investigators Malomoand Olutade (2013), Abd-Elsamee *et al*. (2014), El-Faham *et al*. (2015 and 2016), theyconcluded that no significant different in carcass characteristics for the broiler chicks feeding low protein diet or different ME levels.

Economical efficiency:

Data presented in Table (5) show the economical efficiency of the different dietary treatments (T_1- T_5) and money returned per chicken at the end of experimental period as affected by different levels of super starter diet$_2$. Live body weight, feed intake and feed cost are generally among the most important factors involved in achieve maximum profit from meat production. Results show that, the lowest values of net return (LE) and economical efficiency were recorded for the control treatment (T_1), being 13.84 and 43.33, respectively. While the highest values were recorded for (T_5) treatment and the corresponding values were 20.36 and 57.67 respectively. Moreover, feeding super starter diet$_2$ by different levels from T_2 till T_5 gave the highest relative economic efficiency and the corresponding values were 114.16, 120.57, 126.52 and 133.09 respectively.

CONCLUSION

From the present results, it could be stated that, feeding Hubbard broiler chicks super starter diet at (500g/chick), would have a positive effect on productive performance and economical efficiency, without any adverse effect on carcass characteristics.

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التأثير الغذائى والاقتصادى لاستخدام عليقة السوبر بادئ فى تغذية بدارى التسمين

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أجريت هذه الدراسة للتعرف على تأثير التغذية على عليقة قياسية (٢٣% - عليقة١– بادئ) أو مرتفعة (٢٥% عليقة ٢– سوبر بادئ) فى المحتوى من البروتين الخام على الأداء الإنتاجى وصفات الذبيحة والعائد الاقتصادى لكتاكيت التسمين.

استخدم فى هذه التجربة ٢٢٥ كتكوت ذكر عمر يوم سلالة الهبرد وزعت على ٥ معاملات غذائية بكل معاملة ٣ مكررات بكل منها ١٥كتكوت. استمرت التجربة من (١-٣٥) يوم.

غذيت الكتاكيت على عليقة بادئ (١- ١٤ يوم) فى المعاملات الغذائية كالآتى:

المعاملة الأول: تغذت على عليقة كنترول (٢٣% بروتين)		عليقة١
المعاملة الثانية: تغذت على عليقة مرتفعة البروتين (٢٥% بروتين)	بمعدل ١٢٥جم/طائر	عليقة٢
المعاملة الثالثة: تغذت على عليقة مرتفعة البروتين (٢٥% بروتين)	بمعدل ٢٥٠جم/طائر	عليقة٣
المعاملة الرابعة: تغذت على عليقة مرتفعة البروتين (٣٧٥% بروتين)	بمعدل ٢٥٠جم/طائر	عليقة٤
المعاملة الخامسة: تغذت على عليقة مرتفعة البروتين (٢٥% بروتين)	بمعدل ٥٠٠جم/طائر	عليقة٥

- استكملت تغذية الكتاكيت بالمعاملات من الثانية حتى الخامسةعلى عليقة١ حتى نهاية فترة البادئ (١٤) يوم.
- غذيت كتاكيت التجربة والتى غطى الاحتياجات الغذائية للسلالة من المعاملة الأولى حتى الخامسة على عليقة النامى (١٥- ٢٨ يوم) ثم الناهى (٢٩- ٣٥ يوم).

وكانت النتائج المتحصل عليها كالآتى:

١- زيادة الوزن الحي والوزن المكتسب واستهلاك العلف وتحسن معامل التحويل الغذائى بزيادة كمية السوبر بادئ المقدمة لبدارى التسمين.
٢- أفضل قيم للأداء الإنتاجى (الوزن المكتسب ومعامل التحويل الغذائى ومعامل تحويل البروتين والطاقة) سجلت للكتاكيت المغذاة على ٥٠٠ جرام/طائر سوبر بادئ بالمقارنة بالمعاملات الأخرى.
٣- لم تتأثر معنويًا جميع قياسات الذبيحة كنسبة مئوية للوزن الحى للطائر (الذبيحة، الحوائج، قلب، كبد، قانصة) بالمعاملات الغذائية المختلفة.
٤- أفضل قيم للكفاءة الاقتصادية سجلت للكتاكيت المغذاة على ٥٠٠ جرام/طائر سوبر بادئ وقيمة الكفاءة الاقتصادية النسبية زادت بمعدل (٣٣.٠٩%) بالمقارنة بالكتاكيت المغذاة على عليقة الكنترول.

الخلاصة: تغذية كتاكيت بدارى التسمين على عليقة سوبر بادي بمعدل (٠.٥كجم/ طائر) أثناء فترة البادئ يحسن الأداء الإنتاجى والعائد الاقتصادى.

Table (1): Feed ingredients and chemical analyses of experimental diets.

Ingredients	Experimental Diets			
	Starter (Diet 1)	Super Starter (Diet 2)	Grower (Diet 3)	Finisher (Diet 4)
Yellow Corn Grains	51.55	48.59	57.23	62.59
Soy Bean Meal (44%)	35.00	39.00	29.79	24.70
Corn Gluten Meal (60%)	5.20	6.00	4.90	4.60
Limestone ($CaCO_3$)	1.35	1.35	1.10	1.08
Di-Ca Phosphate	1.90	1.90	1.68	1.55
Salt (NaCl)	0.40	0.40	0.40	0.40
Premix*	0.30	0.30	0.30	0.30
Soy Oil	3.50	2.00	4.00	4.25
DL-Methionine	0.31	0.24	0.24	0.21
Lysine –HCl	0.32	0.20	0.25	0.23
Anti-Oxidant	0.17	0.02	0.11	0.09
Total	100	100	100	100
Chemical Analysis (Calculated)**				
Crude Protein %	23.01	25.01	21.01	19.04
ME Kcal/ Kg diet	3046	2918	3159	3238
Calcium %	1.07	1.06	0.90	0.85
Available Phosphorus %	0.51	0.49	0.45	0.42
Lysine %	1.45	1.44	1.25	1.10
Methionine & Cysteine %	0.69	0.66	0.60	0.54
Price/ Ton (L.E.)	6707	6696	6449	6199

**Each 3 Kg of premix contains: Vitamins: A: 12000000 IU; Vitamins; D3 2000000 IU; E: 10000 mg; K3: 2000 mg; B1:1000 mg; B2: 5000 mg; B6:1500 mg; B12: 10 mg; Biotin: 50 mg; Choline 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.*
***According to **NRC, 1994**.*

Table (2): Effect of different dietary treatments on productive performance.

Items	Dietary Treatments					
	1	2	3	4	5	Sig.
Live body weight (g)	1830.00^{c} ±47.25	2028.33^{b} ±39.19	2046.67^{b} ±28.91	2155.00^{a} ±24.66	2226.67^{a} ±14.52	**
Body weight gain (g)	1790.00^{c} ±47.25	1988.33^{b} ±39.19	2006.67^{b} ±28.91	2115.00^{a} ±24.66	2186.67^{a} ±14.52	**
Feed intake (g)	2940.67^{c} ±71.05	3261.67^{b} ±82.89	3211.00^{b} ±57.76	3402.33^{ab} ±38.30	3484.33^{a} ±41.57	**
Feed conversion ratio (feed/ gain)	1.64^{a} ±0.01	1.64^{a} ±0.01	1.60^{b} ±0.01	1.61^{b} ±0.01	1.59^{b} ±0.01	**
Growth rate	1.91^{b} ±0.01	1.92^{ab} ±0.01	1.92^{ab} ±0.01	1.93^{a} ±0.01	1.93^{a} ±0.01	*

a, b, c, d Means within the same row with different superscripts are significantly different.
*Sig. = Significance, ** (P≤0.01), * (P≤0.05).*

Table (3): Effect of different dietary treatments on protein and energy conversion ratio (PCR, ECR), performance index (PI) and production efficiency factor (PEF).

Items	Dietary Treatments					
	1	2	3	4	5	Sig.
PCR: Protein conversion ratio (g protein/ g gain)	0.35[a] ±0.01	0.35[a] ±0.01	0.34[ab] ±0.01	0.34[ab] ±0.01	0.33[b] ±0.01	*
ECR: Energy conversion ratio (Kcal/ g gain)	5.36[a] ±0.08	5.23[a] ±0.04	5.08[b] ±0.01	5.06[b] ±0.01	5.00[b] ±0.01	**
Performance Index [1] (PI)	111.41[d] ±3.35	123.66[c] ±1.80	127.90[bc] ±1.38	133.96[ab] ±1.60	139.74[a] ±0.38	**
Production Efficiency Factor [2] (PEF)	318.32[d] ±9.59	353.31[c] ±5.15	365.44[bc] ±3.93	382.76[ab] ±4.57	399.26[a] ±1.10	**

*a, b, c Means within the same row with different superscripts are significantly different. Sig. = Significance ** (P≤0.01), * (P≤0.05). 1: North (1981); 2: Emmert (2000).*

Table (4): Effect of dietary treatments on some carcass characteristics.

Items	Dietary Treatments					
	1	2	3	4	5	Sig.
Dressed carcass %	64.17±0.35	66.22±0.21	65.19±1.07	65.91±0.41	65.49±0.99	NS
Liver %	2.68±0.24	2.47±0.29	2.84±0.66	2.96±0.24	2.52±0.04	NS
Gizzard %	1.26±0.03	1.27±0.09	1.10±0.03	1.05±0.01	1.04±0.02	NS
Heart %	0.56±0.02	0.52±0.01	0.51±0.04	0.52±0.04	0.53±0.02	NS
Giblets * %	4.50±0.24	4.26±0.37	4.45±0.58	4.53±0.25	4.09±0.09	NS

*Sig. = Significance, NS = Non Significant. * Giblets = Liver + Gizzard + Heart*

Table (5): Effect of different dietary treatments on some economic traits.

Items	Dietary Treatments				
	1	2	3	4	5
Live body weight (Kg)	1.83±0.04	2.03±0.03	2.05±0.02	2.15±0.02	2.22±0.01
Average feed intake (Kg)	2.94±0.06	3.26±0.08	3.21±0.05	3.40±0.03	3.48±0.04
Feed Cost (LE)	18.91±0.44	20.92±0.50	20.60±0.35	21.79±0.25	22.30±0.25
Total Cost (LE) #	31.91±0.44	33.92±0.50	33.60±0.35	34.79±0.25	35.30±0.25
Total Return (LE) *	45.75±1.18	50.71±0.97	51.17±0.72	53.87±0.61	55.66±0.36
Net Return (LE)	13.84±0.77	16.79±0.48	17.56±0.37	19.08±0.36	20.36±0.11
Economic Efficiency	43.33±1.92	49.47±0.77	52.24±0.57	54.83±0.67	57.67±0.22
Relative Economic Efficiency	100.00±0.00	114.16±1.78	120.57±1.31	126.52±1.56	133.09±0.52

 # Total cost = (feed cost + price of one-day live chicks + incidental costs);
** According to the local price of Kg sold carcass which was 25.00 L.E.*