

**EFFECTS OF REDUCING DIETARY CRUDE PROTEIN
WITH AMINO ACIDS SUPPLEMENTATION ON
PERFORMANCE OF COMMERCIAL WHITE LEGHORN
LAYERS DURING THE SECOND PRODUCTION
PERIOD**

By

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Abstract: *Use of low protein diets could have potential benefits on nitrogen emissions reduction as well as potential cost savings by reducing the utilization of high cost protein sources. An experiment was conducted with 160 Hy-Line W-36 hens which were randomly assigned to one of four dietary treatment groups. Corn-soy based diets varying in dietary crude protein (CP) supplemented with commercially amino acids as follows: [1] 17.5% CP + Met, [2] 15.5% CP + Met, Lys & Trp, [3] 15% CP + Met, Lys & Trp, and [4] 13% CP + Met, Lys, Thr & Trp, were fed from 38 to 50 weeks of age. Cage was considered the experimental unit (4 hens/cage), and each treatment was replicated 10 times. Using body weights (BW), feed consumption (FC), protein intake (PI) and feed conversion ratio (FCR), egg production (EP), egg weights (EW), egg mass (EM) and egg components data as growth and productive parameters during the studied period (12 weeks), one slope, broken-line regression models were employed to estimate the break point for each parameter due to reducing CP in Commercial White Leghorn hens diets.*

Mean differences in BW among dietary CP levels were significantly different ($P \leq 0.001$) as feeding the highest CP diet resulted in heavier hens 1435 g/ hen, but statistically similar when compared to the NRC (1994) recommended group (15 CP; 1385 g/ hen). However, BW of the break point (1457 g/ hen) were significantly estimated ($P \leq 0.001$) in hens fed on the 16.50% CP than those fed on the 13 and 15% CP diet 1184 and 1385 g/ hen, respectively. Protein intake data followed similar trend as of BW, as reducing dietary CP levels resulted in a significant ($P \leq 0.001$) PI linear reduction in hens fed the 13% CP consuming the lowest PI 12.56 g/ hen as

compared to all other dietary CP treatments. However, estimating PI break point, hens fed the 16.85% CP consumed 16.37 g/hen which was higher ($P \leq 0.001$) than hens fed 13, 15 or 16% CP, respectively. Higher linear EP ($P \leq 0.001$; 91.17%) was recorded for hens fed on the 16% CP diet. However, EP break point of 88.10% resulted from 15.50% CP. Heavier EW was recorded for the 18% CP (62.10 g), while the break point analysis showed the feeding 15.50% CP resulted in 61.11 g EW ($P \leq 0.001$). No significant effects due to dietary treatments were noted for FCR, albumen, yolk and shell percentages.

Therefore, based on current results, applying the break point regression model estimates resulted in more accurate data of how much dietary CP could be reduced while maintaining optimum growth and production by amino acids supplementation. Feeding 15 and 16% CP diets supplemented with Met, Lys, Trp or Thr, could be suitable for adequate growth and production for commercial laying hens during second production period.

INTRODUCTION

Currently, there is an interest in reducing the nutrient content of manure as it affects disposal and environmental concerns. Nutrients of greatest concern are usually N and P because of their relative amounts in the manure and compared to that needed for optimum disposal on any given acreage (Leeson and Caston 1996). Dietary energy and protein represent approximately 85% of total feed cost. At present, there are wide ranges of dietary energy (2,685 to 3,100 kcal of ME/kg) and protein levels (13.50 to 19%) being used by the egg industry (Grobas *et al.*, 1999). Dramatic improvements in the productivity of poultry flock in general, and laying hens specifically could be attributed to improvements in feed ration formulations (Yakout *et al.*, 2004). Detailed knowledge of nutrient requirements are indeed of necessity for continuous improvement in productivity (Gunawardana, *et al.*, 2008). Increasing levels of protein (Nahashon *et al.*, 2010, Parsons *et al.*, 1993, Keshavarz and Nakajima, 1995, Leeson, 1989), methionine (Keshavarz, 1995), and lysine (Zimmerman, 1997) have resulted in improvements in production parameters especially in improving egg weights. However, amino acids in excess of the requirements may impair production through several interactions and may result in N environmental pollution. The potential for reducing dietary protein has become a reality because of the availability of

Lys, Met, Thr, and Trp in the market. With the fact that the liquid egg and breaker egg industry growing dramatically during the last decade, there are very few studies in which the effects of the protein on egg composition and egg solids of Hy-Line W-36 hens have been prevailed. With sharp increases in energy cost, it is important to have a better understanding of how to maximize the use of dietary feed rations at different protein levels to optimize performance and yield especially for the egg breaker industry (Gunawardana, *et al.*, 2008).

In order to gain optimal revenue of research resources, an effective procedure can be used to evaluate nutrient requirements (Lamberson and Firman, 2002). Also, utilization of alternative feedstuffs, formulating diets based on digestible amino acids, applications of biomass, bio-refinery of agriculture by-products, and application of ideal protein concept (Baker and Han, 1994; Kerr and Kidd, 1999) may result in utilizing lower crude protein levels than those recommended by NRC (1994) or currently used by the industry. Applying the broken-line models, as an application that yields an objective estimate of the most suitable dietary level of any nutrient may be considered as a fully adequate to optimize growth performance, known as nutrient “*requirement*” (Robbins, 1986; Robbins *et al.*, 1979). Taken in consideration the simplicity of broken-line models, its use for growth data determination is sometimes preferable since it is often easier to interpret (Robbins, 1986).

The current trial was conducted to determine how much dietary crude protein could be reduced, while supplementing diets with synthetic amino acids would serve for better growth and/ or production parameter of commercial white leghorn laying hens during 2nd production phase from 38 to 50 weeks of age.

MATERIALS AND METHODS

Experimental birds and management:

This study was conducted at a private sector farm in Behaira¹ district. One hundred and sixty White Commercial laying hens² at 38 weeks of age were randomized into layer cages and were fed one of four dietary treatment diets (Table 1). Corn-soy based diets varying in dietary protein supplemented with commercially available amino acids as follows: [1]

¹Al-Ashraf for Animal Production farm, Behaira - Egypt.

²White Commercial Leghorn hens (WCL) Hy-Line W36.

17.5% CP + Met, [2] 15.5% CP + Met, Lys & Trp, [3] 15% CP + Met, Lys & Trp, and [4] 13% CP + Met, Lys Trp & Thr were fed from 38 to 50 weeks of age. Treatment diets were formulated on a digestible amino acid basis according to NRC (1994) and Hy-Line W-36 commercial management guide³ recommendations for laying hen nutrients requirements. Cage was considered the experimental unit (4 hens/ cage) with each treatment replicated 10 times.

Feed and water were provided *ad-libitum* all over the experimental period (12 weeks) from 38 to 50 weeks of age. Starting the 38th week, hens were individually weighed, wing-banded and were randomly allocated into treatments based on BW.

All hens were individually weighed once every 4 weeks and at the end of the experiment, while FC was recorded on daily basis. Growth and productive performance criteria were evaluated as of BW, FC, PI, FCR, EP and EM while a weekly, 1- day egg production was used for measuring EW and wet egg components percentages which were conducted every 2 weeks.

Statistical analysis:

A one way analysis was utilized in which all data generated was analyzed by general linear models (GLM) procedures of SAS[®] software (SAS, 2003). In addition, one slope, broken-line regression models (Robbins, 1986; Knowles *et al.*, 1997) were used to estimate how much reduction could be utilized with crude protein for laying hens during the studied period. The following model was used to determine differences $Y_{ij} = \mu + a_i + e_{ij}$; where

Y_{ij} variable measured; μ overall mean; a_i = effect of the i^{th} level and e_{ij} = error component. Significance of difference was based on the probability of a type I error set at ($P \leq 0.05$). The differences among means were tested utilizing Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Reducing dietary CP to 15% was statistically insignificant; however a significant linear reduction of dietary protein to 13% with supplementation of Met, Lys, Trp and Thr resulted in a significant decrease ($P \leq 0.05$) in BW (1184 g./ h; Table 2). The effect of protein on BW was in a disagreement

³Hy-Line W036 commercial management guide 2009-2011. 1755 West Lakes Parkway. West Des Moines, Iowa 50266 U.S.A.

with data reported by Sohail *et al.*, (2003), Grobas *et al.*, (1999), and Keshavarz and Nakajima (1995), who reported no significant effect of reducing dietary protein levels on BW. Mean differences in asymptotic BW among different dietary CP levels were significantly different ($P \leq 0.05$), as feeding the highest CP (17.5% + Met) resulted in heavier hens 1435 g/ hen as compared to the NRC recommended group (15%; 1385 g/ hen). However, significant dietary CP estimate ($P \leq 0.001$) obtained from the one-slope broken line regression model was 16.50% resulting in BW at the break point of (1457 g/ hen), which was heavier than those fed on the 13 and 15% CP diet of 1184 and 1385 g/ hen, respectively. The improvement in BW might be due to the availability and balanced amino acids provided through tested diets. However, lower BW due to feeding the lowest dietary treatment (13% CP) was explained by Cole (1996), as in some cases dietary amino acids could be absorbed in a form that is unavailable to animal, due to production of fructose-lysine. This would lead to inhibiting Trypsin release and Lysine utilization remains at only 10% leading to slower amino acids absorption and eventually poor performance of laying hens. Furthermore, it seems that body protein reserves were gradually depleted in birds fed the reduced-CP diet. Our results obtained confirm that BW reduction was due to lowering dietary CP both linearly and with regression estimating models, and indicating the availability of amino acids (especially Lysine) and better utilization of the feed ration which resulted in better performance as of layers BW at the upper level (diet 1).

Feeding low protein diets supplemented with amino acids non-significantly reduced FC from 97.60 to 95.68 g/ hen/ day. Reducing dietary CP levels resulted in an insignificant ($P \geq 0.001$) FC linear reduction with hens fed the 15% CP consuming the lowest amount of feed of 95.68 g/ h/ d when compared to all other dietary CP treatments. Research results with laying hens reported by (Novak *et al.*, 2007, Novak *et al.*, 2008) drew similar conclusions. Protein intake was significantly reduced ($P \leq 0.001$) with dietary CP reductions, as hens fed the 17.5% diet consumed (10.59%) more as compared to the strain guide recommendation which is used by the industry (15.5% CP), 17.81% more PI when compared to the NRC (1994), and 28.06% when compared to the lowest diet (13% CP), respectively. Zou *et al.*, (2005) reported that reducing dietary PI from 16.3 to 15.3 g/ hen per day reduced EP by 3.2%, while Keshavarz (1995) indicated that EP was only decreased by 1.9% with dietary protein intake reduction from 21.4 to 17.4 g/hen per day. Hens fed the lowest CP (diet 4) presented the poorest

FCR values ($P \leq 0.001$; 2.18 g. feed/ g. egg), while hens fed the other three CP levels had an average of 1.87 g. feed/ g. egg. The one-slope broken point regression analysis resulted in better FCR ($P \leq 0.001$; 1.86 g feed/ g egg mass) at 15.22% CP.

Hen-day egg production was lower in the low protein group as reducing dietary protein levels from 17.5 to 13% linearly reduced ($P \leq 0.001$) EP by 4.23% (compared to the 15% diet; industry) and 10.79% (compared to 13% CP; Table 2). However, results from the one-slope broken line regression model CP estimates for EP showed that the break point of 15.50% CP had 88.10% EP which is supported by the Hy-line 36 guide at this age, but slightly higher than NRC (1994) recommendations. Similarly, Liu *et al.*, (2005) and Wu *et al.*, (2005) reported that reducing dietary protein reduced EP. With respect to EP, the results of this experiment were in agreement with those reported by Novak *et al.* (2006), who suggested that the effects of the reduced-CP diet were more dramatic during the late stage production (43 to 63 weeks of age). Despite the satisfactory results of feeding a reduced-CP diet for short periods Keshavatz and Austic (2004), concluded that feeding reduced-CP diets for a longer period can result in poor egg production. The one-slope broken line regression model CP estimates for EP (15.50%) indicate that CP requirement as estimated by NRC (1994) for laying hens (15%) might also be slightly inappropriate for current laying hens used by the industry as recommended by the strain guide (15.25 to 15.50%).

The heaviest EW was recorded for the 17.5% CP (62.10 g; Table 3), while the one-slope broken line regression model CP estimates for EW showed that a break point was detected by feeding 15.50% CP resulting in 61.11 g EW ($P \leq 0.001$). The lowest EW was 58.38 g recorded for hens fed the 13% CP, although this diet maintained hen needs but this lower EW may be attributed to an inadequate level of total N (Leeson and Caston, 1996). However, comparable EW between reduced-CP diets and Hy-line 36 guide recommendations used by the industry diet (15.50% CP) in the present study suggest that the reduced-CP diet was well fortified with essential amino acids and had an adequate level of total N. The improvement in EW in upper three CP diets might be; as mentioned earlier in BW data; related to the availability and balanced amino acids provided through tested diets.

Egg mass data presented in (Table 3) showed that diet 3 (15% CP) maintained EM at 51.15 g, while reducing CP to 13% (diet 4) resulted in a

significantly lower EM ($P \leq 0.001$; 46.42 g.). The broken line-slope estimated better EM of 52.13 g at 15.40% CP, which is slightly lower than the recommended by the strain guide of 15.50%. Hens fed the reduced-CP diet produced fewer eggs and, as a result, had lower egg mass compared with other dietary treatments. This discrepancy with the present findings may be due to a difference in essential amino acid balance between treatments. Sohail *et al.*, (2003) demonstrated that essential amino acids had a significant influence on egg weight so that removing an indispensable amino acid resulted in reduced egg weight within 2 weeks. Data analysis showed a significant ($P \leq 0.05$) effect of period on EW. This would be expected because the egg size is small in the beginning of the laying period and tends to increase with age. It is concluded, based on these results of the present study and a review of the relevant literature, that the response in egg production was more sensitive to the reduced CP diets than was egg size.

Higher albumen percentages (Table 3) confirm EW data as noted for hens fed on the 15% CP diet (61.03%). However, no significant effects ($P \geq 0.05$) due to dietary treatments were noted for egg components percentages. Hens fed the 15.50 and 13% CP diets had numerically ($P \geq 0.05$) higher yolk (25.93%) and shell (14.00%), respectively.

Current research results indicate that CP requirements (15%) of laying hens recommended by NRC (1994) and the strain guide recommendations (15.50%) is adequate to maintain FC EP, EW EM and egg components. However, 16.50% is needed to maintain better BW, PI (16.85%), and 15.22% for FCR. Applying the one-slope broken Line regression model estimates resulted in obtaining accurate data of which dietary CP would serve better for optimum growth and productivity. Feeding 15 or 16% CP diet supplemented with Met, Lys, Trp or Thr, could be suitable for adequate growth and production in order to ensure that dietary CP will not be in excess for commercial laying hens during second production cycle (38 to 50 weeks).

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

Ingredients, %	Diet			
	1	2	3	4
Corn yellow	59.50	63.5	62.00	62.00
Soybean Meal (48%)	25.00	20.00	20.00	15.00
Di-Calcium P	1.99	2.02	2.06	2.09
Lime Stone	9.68	9.69	9.68	9.70
Salt	0.40	0.40	0.40	0.40
wheat bran	2.90	3.50	1.00	3.40
Oil	0.0024	0.0022	0.0031	0.0041
Meth.	0.17	0.22	0.24	0.29
Lys	--	0.04	0.06	0.19
Thr	--	--	--	0.06
Trp	--	0.03	0.03	0.06
Vit & Min premix ¹	0.30	0.30	0.30	0.30
Sand	0.06	0.30	4.23	6.50
Total	100.00	100.00	100.00	100.00
Calculated Analysis, %				
CP	17.51	15.60	15.00	13.00
ME. (kcal kg)	2870.00	2870.00	2870.00	2870.00
Lysine	0.82	0.82	0.82	0.82
Methionine	0.45	0.48	0.49	0.52
TSAA	0.75	0.75	0.75	0.75
Threonine	0.54	0.54	0.54	0.54
Trptophan	0.22	0.22	0.22	0.22
Ca.	4.20	4.20	4.20	4.20
Avail P.	0.48	0.48	0.48	0.48
Total P.	0.73	0.72	0.70	0.70

¹Provide (per kg of diet): Vit A, 8900 IU; Vit E, 16 IU; Vit D3, 3500 IU; riboflavin, 6mg; Ca pantothenate, 7mg; niacin, 30mg; choline chloride, 110mg; vitamin B₁₂, 22.1mg; vitamin B₆, 3.3mg; thiamine (as thiamine mononitrate), 2.2 mg; folic acid, 0.65 mg; d- biotin, 60mg. Trace mineral (mg /kg diet): Mn, 88; Zn, 90; Fe, 65; Cu, 5.5; Se, 0.3

Laying hens, crude protein, amino acid diets, break point regression model.

Table 2: Growth and productive performance of commercial laying hens fed different dietary CP levels.

Dietary Protein, %	BW ^{1,8} (g./h)	FC ² (g./h./d.)	PI ^{3,9} (g./h./d.)	FCR ^{4,10} g. feed/g. egg	EP ^{5,11} (%)
17.5	1435 ^a ± 25.52	97.02 ± 1.03	17.46 ^a ± 0.18	1.88 ^a ± 0.05	88.43 ^a ± 2.56
15.5	1399 ^a ± 13.71	97.60 ± 1.52	15.61 ^b ± 0.25	1.85 ^a ± 0.03	91.17 ^a ± 1.87
15.0	1385 ^a ± 23.35	95.68 ± 1.25	14.35 ^c ± 0.19	1.90 ^a ± 0.04	84.69 ^{ab} ± 2.39
13.0	1184 ^b ± 20.31	96.60 ± 1.71	12.56 ^d ± 0.22	2.18 ^b ± 0.11	78.89 ^b ± 2.20
Protein estimate ^{6,7}	1457 ± 26.06	--	16.37 ± 0.24	1.86 ± 0.03	88.10 ± 1.34

¹Protein effect (linear $P \leq 0.001$)

²Protein effect (linear $P = 0.81$; NS: non-significant)

³Protein effect (linear $P \leq 0.001$)

⁴Protein effect (linear $P \leq 0.001$)

⁵Protein effect (linear $P \leq 0.003$)

⁶Protein estimates were obtained from one-slope broken line regression models and are expressed as a percentage of the diet.

⁷ $Y=L+U(R-X_{LR})$; where L: the ordinate of the broken line in the curve; R: the abscissa of the broken line in the curve (the estimate); X_{LR} : a value of x less than R and U: the slope of the line for X less than R.

⁸BW, $Y=1457-53.87(16.50-X_{LR})$.

⁹PI, $Y=16.37-1.0014(16.85-X_{LR})$.

¹⁰FCR, $Y=1.86-0.14(15.22-X_{LR})$.

¹¹EP, $Y=88.10-0.50(15.50-X_{LR})$.

Table 3: Egg production and components of commercial laying hens fed different dietary CP levels.

Dietary Protein, %	EW ^{1,8}	EM ^{1,9}	Albumen ³	Yolk ⁴	Shell ⁵
	(g.)	(g.)	(%)		
17.5	62.10 ^a ± 0.42	51.86 ^a ± 1.05	60.91 ± 0.17	25.31 ± 0.33	13.53 ± 0.15
15.5	60.39 ^b ± 0.47	52.40 ^b ± 0.68	60.88 ± 0.22	25.93 ± 0.36	13.28 ± 0.22
15.0	60.84 ^{ab} ± 0.53	51.15 ^a ± 0.40	61.03 ± 0.34	25.34 ± 0.44	13.48 ± 0.14
13.0	58.38 ^c ± 0.37	46.42 ^b ± 0.49	60.26 ± 0.26	25.11 ± 0.27	14.00 ± 0.22
Protein estimate ^{6,7}	61.11 ± 0.28	52.13 ± 0.49	--	--	--

¹Protein effect (linear $P \leq 0.001$)

²Protein effect (linear $P \leq 0.001$)

³Protein effect (linear $P = 0.17$; NS: *non-significant*)

⁴Protein effect (linear $P = 0.10$; NS: *non-significant*)

⁵Protein effect (linear $P = 0.07$; NS: *non-significant*)

⁶Protein estimates were obtained from one-slope broken line regression models and are expressed as a percentage of the diet.

⁷ $Y=L+U(R-X_{LR})$; where L: the ordinate of the broken line in the curve; R: the abscissa of the broken line in the curve (the estimate); X_{LR} : a value of x less than R and U: the slope of the line for X less than R.

⁸EW, $Y=61.11-1.82(15.50-X_{LR})$.

⁹EM, $Y=52.13-2.37(15.40-X_{LR})$.

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Laying hens, crude protein, amino acid diets, break point regression model.

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الملخص العربي

تأثير خفض البروتين الخام مع إضافة الأحماض الأمينية على الأداء الإنتاجي للدجاج البياض التجاري خلال فترة الإنتاج الثانية

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استخدام أعلاف منخفضة البروتين له العديد من الفوائد المحتملة مثل التقليل من التلوث بالنيتروجين فضلا عن توفير في التكلفة المحتملة عن طريق الحد من استخدام مصادر البروتين عالية التكلفة. أجريت هذه الدراسة على ١٦٠ دجاجة Hy-Line W-36 على عمر ٢٨ أسبوعا حيث تم تقسيمها عشوائيا إلى أربعة أعلاف تجريبية. تكونت الأعلاف من الذرة الصفراء و كسب فول الصويا و اختلفت في محتواها من البروتين الخام حيث اضيف اليها احماض امينية مصنعة كالتالي: [1] 17.5% CP + Met, [2] 15.5% CP + Met, Lys & Trp, [3] 15% CP + Met, Lys, Thr & Trp, [4] 13% CP + Met, Lys & Trp, and CP + Met, و تم التغذية عليها في خلال الفترة من 38 إلى 50 أسبوع من العمر. أعتبر القفص هو الوحدة التجريبية (٤ دجاجات / قفص) وكررت كل معاملة ١٠ مرات. تم قياس صفات وزن الجسم، استهلاك العلف، استهلاك البروتين، كفاءة التحويل الغذائي، إنتاج البيض، وزن البيض و مكونات البيض كيميائيا للنمو و الإنتاجية خلال فترة الدراسة (١٢ أسبوعا)، و تم تطبيق معادلات الانحدار لتقدير أنماط النمو و تحديد نقطة التعبير في احتياجات الدجاج البياض التجارية من البروتين الخام لكل صفة على حدة كنتيجة لتقليل البروتين المقدم في العلف.

اختلفت متوسطات وزن الجسم بين مستويات البروتين بشكل معنوي ($P \leq 0.001$) حيث ان التغذية على العليقة الاعلى في البروتين ادت الى أنقل وزن للدجاجات 1٤٢٥ جم/ دجاجة ولكن في نفس الوقت متساوية معنويا مع الدجاجات المغذاه على اعلاف مملئة لتلك الموصى بها من قبل (NRC (1994 (١٥%، ١٣٨٥ جم/ دجاجة). نقطة التغير في وزن الجسم ١٤٥٧ جم/ دجاجة تم الحصول عليها عند التغذية على ١٦.٥% بروتين، و هي اعلى من تلك للدجاجات المغذاه على ١٣ او ١٥% بروتين (١١٨٤ و ١٣٨٥ جم / دجاجة) على التوالي. نتاج إستهلاك البروتين إتبع نفس نتاج وزن الجسم حيث ان خفض نسبة البروتين في العلف ادى الى نقص معنوي لإستهلاك البروتين وخاصة للدجاجات المغذاه على ١٣% بروتين (١٢.٥٦ جم/ دجاجة) مقارنة بالمعاملات الأخرى. نقطة التغير في استهلاك البروتين ١٦.٢٧ جم/ دجاجة تم الحصول عليها عند نسبة بروتين ١٦.٨٥% و كانت اعلى من تلك للدجاجات المغذاه على ١٣، ١٥ او ١٥.٥% بروتين. أعلى نسبة إنتاج بيض تم الحصول عليها من الدجاجات المغذاه على ١٧.٥% بروتين (٦٢.١٠%) و لكن نقطة التغير لوزن البيض (٦١.١١ جم) تم الحصول عليها عند ١٥.٥٠% بروتين. لم يلاحظ تأثيرات معنوية للمعاملات الغذائية على كلا من الكفاءة الغذائية، النسبة المئوية لبياض البيض، صفار البيض او نسبة القشرة.

لذلك، استنادا إلى النتائج الحالية، وبتطبيق نموذج الانحدار لنقطة التغير ادى الي تقديرات أدق لتحديد الي اى مدى يمكن خفض البروتين الخام مع الحفاظ على تحقيق النمو الأمثل والإنتاجية المتناسبة. التغذية على أعلاف تحتوي على ١٥% او ١٦% بروتين المضاف اليها أحماض أمينية مصنعة، يمكن أن تكون مناسبة لنمو جيد و إنتاجية اعلى للدجاج البياض التجاري خلال الفترة الثانية للإنتاج.