EFFECT OF PROTEIN CONCENTRATE WITHDRAWAL AND REDUCING THE CRUDE PROTEIN IN DIETS AND ADDING AMINO ACIDS ON PRODUCTION PERFORMANCE OF LAYING HENS

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ABSTRACT.

The study was aimed to demonstrate the effect of withdrawing the protein concentrate and reducing the crude protein to the level of (16 and 15%) in the diets and supplementing them with a mixture of amino acids (methionine, lysine and threonine) at a rate of 1, 1.5, 2% on the productive performance of laying hens. 128 laying hens of the Lohmann Brown were used, at the age of 21 weeks. They were randomly distributed in to 8 treatments, with 8 replications for each treatment, as each replicate includes 2 chickens (16 chickens/treatment). The experimental treatments were as follows: T1 the control (standard diet), T2 a treatment devoid of the protein concentrate, and the T3, T4, and T5 Reducing the percentage of crude protein by 1% and adding a mixture of amino acids by 1, 1.5, and 2%, respectively , and the T6, T7, and T8 Reducing the percentage of crude protein by 2% and adding a mixture of amino acids by 1, 1.5, and 2%, respectively. The results showed that there were no significant differences in the interaction rates for the protein reduction treatments 1 and 2%, but it was observed that there was a significant superiority (P<0.05) in egg production, egg weight rate, feed consumption rate, feed conversion efficiency, egg mass and rate of body weight is in favor of treatments adding a mixture of amino acids at a rate of 1.5 and 2% and with a reduced percentage of protein 1 and 2% compared to the control treatment with out of the protein concentrate. It can be concluded from this study that adding a mixture of amino acids at a rate of 1.5 and 2% and reducing the percentage of protein by (1 and 2%) led to a significant improvement in most productive traits compared to the control treatment (with out of protein concentrate).

Keywords: methionine, lysine, threonine, Lohmann Brown.

تأثير سحب المركز البروتيني وخفض البروتين الخام في العلائق ودعمها بخليط من الاحماض الامينية الاساسية في الاداء الانتاجي للدجاج البياض

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المستخلص .

هدفت الدراسة الحالية لبيان تأثير سحب المركز البروتيني وخفض نسبة البروتين الخام الى مستوى 16 و 15% في العلائق و دعمها بخليط من الاحماض الامينية (المثيونين, اللايسين و الثريونين) بنسبة (1 ,1.5 ,2%) في الأداء الانتاجي للدجاج البياض . استعمل 128 دجاجة بياضه نوع لوهمان البني بعمر 21 اسبوع , وزعت عشوائياً على 8 معاملات وبواقع 8 مكررات لكل معاملة إذ يحتوي كل مكرر على 2 دجاجة أي (16 دجاجة / معاملة) و كانت معاملات التجربة على النحو الاتي : T1 السيطرة (عليقة قياسية) و T2 (معاملة خالية من المركز البروتيني), والمعاملات T3 , T4 و T5 (خفض نسبة البروتين الخام 1% وإضافة خليط من الاحماض الامينية بنسبة 1 ,1.5 ,2 % على التوالي), والمعاملات T6 , T7 و T8 (خفض نسبة البروتين الخام 2% وإضافة خليط من الاحماض الامينية بنسبة 1 ,1.5 ,2 % على التوالي) . بينت النتائج عدم وجود فروقاً معنوية في نسب التداخل لمعاملات خفض نسبة البروتين 1 و2 % , ولكن لوحظ حصول تفوق معنوي (P<0.05) في صفة انتاج البيض , معدل وزن البيض , معدل العلف المستهلك , كفاءة التحويل الغذائية , كتلة البيض و معدل وزن الجسم لصالح معاملات اضافة خليط الاحماض الامينية بنسبة 1.5 و 2 % والمخفضة فيها نسبة البروتين 1 و 2 % مقارنة مع معاملة المقارنة الخالية من المركز البروتيني . يمكن الاستنتاج من هذه الدراسة بأن إضافة خليط الاحماض الامينية بنسبة 1.5و 2% وخفض نسبة البروتين بمقدار (1 و2 %) أدى إلى تحسن معنوي في اغلب الصفات الانتاجية مقارنة مع معاملة السيطرة (الخالية من المركز البروتيني).

الكلمات المفتاحية : المثيونين, اللايسين, الثريونين, لوهمان البني.

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INTRODUCTION

The increasing costs resulting from the high prices of feed and raw materials involved in the formation of feeds, as well as the growing concern about intensive poultry rearing and its impact on the environment through the secretion of nitrogen from waste due to the amount of protein provided in excess of the bird's need, has prompted nutrition experts to prepare studies to estimate the optimal levels of dietary protein and components others in poultry diets (28,32). Recent studies have directed towards finding alternatives by using natural food additives [1,2,3,17,18], reducing the percentage of crude protein in the diets, and replacing protein concentrates with essential amino acids in order to obtain economical diets with a low level of protein that are not stressful for the bird and maintain the general health of him. (4,31,34). Proteins are biological molecules consisting of one or more chains of amino acids. Proteins perform many and varied properties within the bodies of living organisms, including structural functions for cells and organs, productive functions, stimulating metabolic reactions, and DNA replication, The important property that allows proteins to multiply these functions is their ability to bind to molecules. Others (22,23), proteins consist of a group of amino acids that are linked to each other by peptide bonds with different compositions in the quality and number of amino acids involved in the synthesis of that protein. Therefore, there is a difference in the composition of plant proteins from animal proteins (14,40). Methionine is one of the essential amino acids with the highest priority in poultry diets, as it is the first identified amino acid and has multiple important biological functions in bird species (6). It has multiple and very important roles, including protein synthesis, as it is a donor of the methyl group in the process of transmethylation, which contributes to the synthesis of many compounds. such as creatine, carnitine, betaine, cysteine, homocysteine, and choline, a donor to the sulfur atom through the process of transsulfuration to contribute to the formation of compounds containing the sulfur element in their chemical structure, such as glutathione (GSH) and taurine (15), contributing to the formation of the enzymatic coenzyme A and S-adenosylmethionine (SAM), which has an effective role. In various metabolic processes (42). Lysine (Lys) is considered one of the essential amino acids and is the second determining factor. Accurate estimates of amino acid balance requirements are expressed as a ratio to the amino acid lysine in the composition of poultry diets (22). In addition to its essential role in the biosynthesis of proteins and peptides, lysine acts as a substrate to synthesize many non-peptide molecules (38,39). The level of total sulfur amino acids (TSAA) has important and vital functions in the bird's body, as it is considered the key to protein synthesis, as well as its role in donating the methyl group and forming S-adenosylmethionine and its secondary metabolites such as carnitine, polyamines, glutathione, and taurine (7). threonine (Thr) it is an essential amino acid and is also known as ∝-amino-β-hydroxybutyric acid. It is the third limiting amino acid in diets (6,31). It is an important biomolecule that has a vital effect on protein synthesis, energy metabolism, and enhancing the bird's growth by enhancing immune functions and maintaining the bird's health (9). Previous studies indicate that protein levels have a positive effect on the qualitative characteristics of the egg, and that adding the amino acids methionine, lysine, and threonine improves the productive performance of laying hens and improves the qualitative characteristics of the eggs (27,30). Due to the lack of studies on introducing a combination of amino acids and replacing them completely with protein concentrates while reducing the level of crude protein, this study was carried out to find the best level of adding amino acids to of productive performance to reduce the costs protein concentrates and find alternatives to the problem of the scarcity of protein concentrates.

MATERIALS AND METHODS.

The experiment was conducted in the Poultry farm of the Department of Animal Production - College of Agricultural Engineering sciences - University of Baghdad / Abu Ghraib, for the period from 2022/1/1 to 2022/8/1, for a period of 182 days, to study the effect of replacing a mixture of amino acids (methionine, lysine, and threonine) with the protein concentrate in low crude protein diets for laying hens' on productive performance. 128 Lohmann Brown laying hens at the age of 21 weeks were used in the experiment. They were randomly distributed among 8 treatments, with 8 replicates for each (2 hen/replicate).The hens were fed on a balanced diet of protein and energy (both according to the amount of protein determined for each treatment), The first treatment, T1, positive control with a standard diet, while the second treatment, T2, was a negative control with a standard diet, from which the protein concentrate was stripped, and the treatments were (T3, T4, T5) The crud protein percentage was reduced by 1% and a mixture of amino acids was added (methionine, lysine, and threonine) by (1, 1.5, and 2%), respectively, with the removal of the protein concentrates. As for the treatments (T6, T7, T8), the crud protein percentage was reduced by 2%, and amino acids were added by (1, 1.5, and 2%), respectively, with the withdrawal of the protein concentrates as in Table .1. The hens were raised in a hall according to the cage system. The dimensions of the cage were (40 * 40 * 45 cm), with 2 birds per cage. Water was provided adlibitum. As for the diet, it was provided according to the age stage of the laying hens(table.1) according to the Lohmann Brown guide. during the period of the experiment, the measurements were taken for 6 periods, each period included 28 days. Productive traits were measured, including egg production percentage (H.D.%), egg weight rate, feed conversion efficiency, egg mass, and body weight rate . A completely randomized design (CRD) was used as a 2 × 3 factorial experiment in analyzing the various parameters in the studied traits. The significant differences between the means were compared with the Duncan (11) multinomial test, and the ready-made program SAS (33) was used in the statistical analysis.

RESULTS AND DISCUSSION

Egg production(H.D%): The results from Table 2. indicate that there are no significant differences in the interaction of protein percentages (15, 16 %) and for all periods for the egg production rate characteristic H.D. %. when studying the interaction in the rates of adding a mixture of essential amino acids (methionine, lysine and threonine), the results showed that there were significant differences (P<0.05) for all periods and the general rate, as the comparison treatment T1 (standard diet) excelled and there were no differences between it and treatments for adding a mixture of amino acids at a rate of (1, 1.5 and 2%) compared to the (negative) control treatment T2 without the protein concentrate. As for the general average in terms of egg production percentage, H.D.% it was observed that there were significant differences (P<0.05) between the control treatments T1, the treatments of adding a mixture of amino acids T3, T4, and T5(adding a mixture of amino acids and reducing the percentage of crude protein by 1%) and T8. , T9, T10 (adding a mixture of amino acids and reducing the percentage of crude protein by 2%) compared to the negative control treatment T2 (a diet devoid of protein concentrate), as treatment T8 (adding a mixture of amino acids by 1.5% and reducing the percentage of crude protein by 2%) recorded the highest egg production rate (94.04%) did not differ significantly with the T1 (positive control treatment).

Table 1. Composition and calculation of experimental diets

Components %	T1	T2	T3	T4	T5	T6	T7	T8
yellow corn	47.2	47	47.6	48.6	48.3	50.2	50.2	49.6
Wheat (local)	16.8	16.6	17.4	16.2	16	16.5	16	17.6
Soybean meal 48%crude protein	17.7	22	19.8	20.1	20.3	17.1	17.4	17.6
Protein (1) concentrat	5	—	—	—	—	—	—	—
Wheat bran	3.6	3.5	2.9	2.3	2.1	4	3.5	2
Yellow corn oil	0.8	1	1.1	1.1	1.1	1	1.2	1
limestone	8.1	8	8.1	8.1	8.1	8.1	8.1	8.1
Di-calcium phosphate (DCP).	0.4	1.5	1.7	1.7	1.7	1.7	1.7	1.7
Salt	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Mixture of vitamins and minerals	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Amino acids mixture	—	—	1	1.5	2	1	1.5	2
Total	100	100	100	100	100	100	100	100
calculated Analysis (2)								
Crude protein %	17	17	16	16	16	15	15	15
Energy (kilo calories / kg)	2761.04	2760.1	2757.3	2752.80	2750.17	2755.74	2758.96	2756.16
Methionine %	0.4	0.4	0.251	0.251	0.251	0.238	0.2389	0.238
Lysine %	0.9	0.9	0.781	0.785	0.788	0.712	0.71	0.716
Threonine%	—	—	0.58	0.58	0.58	0.54	0.539	0.539
Calcium %	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Available phosphorous %	0.39	0.36	0.39	0.39	0.39	0.39	0.39	0.39

1- Protein concentrate for laying hens Wafi Dutch origin: energy 2125 kilo/calorie, crude protein 40%, calcium 5%, available phosphorus 3.85%, methionine 2.85, lysine 3.8%, methionine + cysteine 3.29%.

2- According to the chemical composition of the feed materials, according to what was mentioned in(27)

Average egg weight (g)

The results in Table 3. indicate that there are no significant differences in the interaction of protein percentages (15 and 16%) for all periods and the general average egg weight. When studying the interaction in the rates of adding a amino acids mixture : methionine, lysine and threonine in the average egg weight (g), the results showed that there were significant differences (P<0.05) in all periods and in the general rate, as the comparison treatment (standard diet) excelled. The treatments for adding a mixture of amino acids at a rate of (1, 1.5 and 2%) were significant (P<0.05) (on the second comparison treatment without of the protein concentrate and for the first, second and third periods. As for the fourth

Table 2. The effect of withdrawing the protein concentrate and reducing the crude protein in the diets and supplementing them with a mixture of essential amino acids on egg production H.D% for six periods of 21-44 weeks for laying hens. (mean ± standard error)

Egg production H.D.%								
Influencing factors		1 21−24	2 25−28	3 29−32	4 33−36	5 37−40	6 41−44	1−6 21−44
protein ratio	16%	80.90±3.04	89.82±2.70	87.83±3.03	83.25±3.77	81.10± 4.28	81.56± 3.88	84.08±3.15
	15 %	83.30±2.64	89.69±2.70	87.52±3.01	83.61±3.80	81.37±4.30	81.78± 3.89	84.55±3.17
significant		N.S	N.S	N.S	N.S	N.S	N.S	N.S
control +		87.72± 2.54 a	95.99± 0.85 a	96.32± 1.23 a	94.86± 1.25 a	94.37± 0.90 a	93.76± 1.28a	93.84± 1.00 a
control -		68.75± 6.14 b	60.26±4.49 b	53.12± 4.01 b	38.17± 3.44 b	29.90± 4.05 b	35.93± 4.04 b	47.69± 3.84 b
Amino acid mixture	1%	83.03± 3.78 a	98.54± 0.54 a	96.98± 0.66 a	95.08± 0.98 a	93.75± 1.18 a	91.96±1.31 a	93.22± 0.90 a
	1.5%	88.30± 3.40 a	97.43± 0.76 a	95.08± 0.88 a	94.64± 0.92 a	93.86± 0.95 a	92.29± 1.02 a	93.60± 0.86 a
	2%	82.70± 4.40 a	96.54± 0.75 a	96.87± 0.59 a	94.42± 1.02 a	94.3± 1.02 a	94.42± 1.07 a	93.21±1.06 a
significant		**	*	*	*	*	*	*
control +	T1	87.72±3.71	95.99± 1.25 a	96.32 ±1.80 a	94.86±1.83 a	94.37±1.32 a	93.76±1.88 a	93.84± 1.46 a
control -	T2	68.75±8.99	60.26± 6.57 b	53.12± 5.87 b	38.17±5.03 b	29.90± 5.93 b	35.93 ± 5.91 b	47.69± 5.62 b
% 16 1%	T3	77.00±6.95	98.88± 0.46 a	97.99± 0.71 a	95.08± 1.60 a	93.75± 1.65 a	91.74±1.96 a	92.41± 1.49 a
% 16 1.5 %	T4	87.76±4.63	97.76± 0.99 a	95.08± 1.33 a	94.64± 1.47 a	93.75± 1.50 a	92.63±1.52 a	93.60± 1.36 a
% 16 2%	T5	83.25±7.54	96.20± 1.23 a	96.65± 0.98 a	93.52± 1.06 a	93.75± 1.43 a	93.75±1.96 a	92.85± 1.86 a
control +	T6	87.72±3.71	95.99± 1.25 a	96.32± 1.80 a	94.86± 1.83 a	94.37± 1.32 a	93.76±1.88 a	93.84± 1.46 a
control -	T7	68.75±8.99	60.26±6.57 b	53.12± 5.87 b	38.17± 5.03 b	27.90± 6.79 b	35.93± 5.91 b	47.35± 5.77 b
% 15 1%	T8	89.06±1.66	98.21± 1.01 a	95.98± 1.05 a	95.08± 1.25 a	93.75± 1.81 a	92.18±1.87 a	94.04± 1.87 a
% 15 1.5 %	T9	88.83±5.30	97.09± 1.21 a	95.08± 1.25 a	94.64±1.21 a	93.97± 1.25 a	91.96± 1.47 a	93.60± 1.15 a
% 15 2%	T10	82.14±5.11	96.87±0.93 a	97.09± 0.74 a	95.31± 1.78 a	94.86± 0.78 a	95.08±0.99 a	93.56± 1.1 a
significant		N.S	*	*	*	*	*	*

• Different letters within one column are significantly different at (P<0.05) or (P<0.01) .

• Transactions: T1 (positive) control treatment, T2 (negative) control treatment (T3, T4, T5) The percentage of crude protein was reduced by 1% from the control treatment with the addition of a mixture of amino acids (methionine, lysine, and threonine) by (1, 1.5, and 2%), respectively, with the withdrawal of the protein concentration from these diets. As for the treatments (T6, T7, T8), the percentage of crude protein was reduced by 2% from the comparison treatment, adding an amino acids mixture by (1, 1.5, 2%). respectively with protein concentrations without

and fifth periods, the results showed superiority to the first comparison treatment (containing the protein concentrate) significantly (P<0.05) over the rest of the experimental treatments, as they recorded the highest average egg weight (63.37 and 62.75 gm), respectively. As for the sixth period, it was observed that the first comparison treatment was significantly superior (P<0.05) over both the second comparison treatment and the addition treatment (1% mixture of amino acids) and it did not differ significantly with the treatments of adding a mixture of amino acids (1.5 and 2%). As for the general average, the results showed that the first comparison treatment was significantly superior (P<0.05) over the rest of the intervention treatments. As for the experimental parameters, the results showed that for the general average, treatment T1 was significantly superior (P<0.05) over both treatments T2 and T8 (the negative comparison treatment and the reduction treatment). The percentage of crude protein was 2% and the addition of a mixture of amino acids at a rate of 1.5%, respectively) and there were no significant differences with the rest of the experimental treatments.

Table 3. The effect of withdrawing the protein concentrate and reducing the crude protein in the diets and supplementing them with a mixture of essential amino acids on Average egg weight (g) for six periods of 21-44 weeks for laying hens. (mean ± standard error)

Average egg weight (g)								
Influencing factors		1 21-24	2 25-28	3 29-32	4 33-36	5 37-40	6 41-44	1-6 21-44
protein ratio	16%	57.05±0.46	60.22±0.65	60.42 ± 0.73	59.62 ±0.73	58.31± 0.77	59.69± 0.71	59.22±0.58
	15%	56.91±0.41	59.88±0.62	60.19±0.73	60.06± 0.63	58.42±0.76	60.16±0.74	59.27±0.57
significant		N.S	N.S	N.S	N.S	N.S	N.S	N.S
control +		57.28± 0.73 a	62.37±0.73 a	62.81± 0.51 a	63.37±0.50 a	62.75±0.55 a	62.99±0.31 a	61.93±0.64 a
control -		53.81±0.44 b	54.25±0.77 b	52.56± 1.03 b	53.47±0.62 c	50.48±0.97 c	51.90± 1.07c	52.74± 0.48 c
Amino acids mixture	1%	57.80± 0.38 a	61.97± 0.47 a	61.78± 0.40 a	60.42±0.56 b	59.06±0.45 b	60.88±0.21 b	60.32±0.21 b
	1.5%	57.50±0.56 a	60.76± 0.59 a	62.25± 0.51 a	61.06±0.45 b	59.46±0.39 b	62.30±0.25 ab	60.56±0.28 b
	2%	58.52±0.63 a	60.89 ± 0.83 a	62.12± 0.48 a	60.90±1.11 b	60.07± 0.56 b	61.55±0.28 ab	60.67±0.43 b
significant		*	*	*	*	*	*	*
control +	T1	57.28±1.08 a	62.37±1.06 a	62.81±0.75 a	63.37±0.74 a	62.75±0.80 a	62.99±0.31 a	61.93±0.64 a
control -	T2	53.81±0.65 b	54.25±1.14 b	52.56±1.51 b	53.47±0.90 c	50.48±1.42 c	51.90±1.56 b	52.74±0.70 c
16% 1%	T3	58.23±0.50 a	62.83±0.55 a	62.03±0.51 a	60.62±1.09 ab	59.35±0.85 b	60.93±0.37 a	60.67±0.37 ab
16% 1.5%	T4	57.07±1.00 a	60.59±0.74 a	62.40±0.58 a	60.89±0.65 ab	59.26±0.74 b	61.79±0.41 a	60.32±0.45 ab
16% 2%	T5	58.85±1.00 a	61.06±1.40 a	62.40±0.64 a	59.77±2.04 b	59.71±0.69 b	60.84±0.29 a	60.44±0.76 ab
control +	T6	57.28±1.08 a	62.37±1.06 a	62.81±0.75 a	63.37±0.74 a	62.75±0.80 a	62.99±0.31 a	61.93±0.64 a
control -	T7	53.81±0.65 b	54.25±1.14 b	52.56±1.51 b	53.47±0.90 c	50.48±1.42 c	51.90±1.56 b	52.74±0.70 c
15% 1%	T8	57.38±0.58 a	61.12±0.66 a	61.54±0.65 a	60.23±0.41 ab	58.78±0.34 b	60.83±0.23 a	59.98±0.14 b
15% 1.5%	T9	57.92±0.54 a	60.94±0.97 a	62.21±0.89 a	61.24±0.66ab	59.67±0.33 b	62.80±0.18 a	60.80±0.33 ab
15% 2%	T10	58.19±0.82 a	60.73±1.00 a	61.84±0.75 a	62.03±0.86 ab	60.43±0.92ab	62.26±0.34 a	60.91±0.44 ab
significant		*	*	*	*	*	*	*

• different letters within one column are significantly different at (P<0.05) or (P<0.01)

Egg mass (g): The results shown in Table .4 indicate that there are no significant differences in the interaction of protein percentages (16, 15%) and for all periods and the general rate, and when studying the interaction in the rates of adding a mixture of essential amino acids in the mass rate Eggs (g), as the results showed that for all periods 21-44 weeks, the first control treatment and the treatment adding a mixture of amino acids in proportions (1, 1.5, 2%) were significantly (P<0.05) superior to the second control treatment (without the protein concentrate and from amino acids), and the data for the experimental treatments in the general rate of egg mass indicate a significant superiority (P<0.05) in favor of the treatments (T1, T3, T4, T5, T8, T9, T10) compared to the T2 treatment and for all periods and the general rate.

Table 4. The effect of withdrawing the protein concentrate and reducing the crude protein in the diets and supplementing them with a mixture of essential amino acids egg mass (g) for six periods of 21-44 weeks for laying hens (mean ± standard error

Influencing factors			Egg mass (g)						
			1 21-24	2 25-28	3 29-32	4 33-36	5 37-40	6 41-44	1-6 21-44
protein ratio	16%		46.21±1.79	54.53±1.94	53.69± 2.18	50.29±2.51	48.35±2.74	49.60±2.59	50.44±2.13
	15 %		47.44±1.54	54.11±1.89	53.27±2.15	50.94±2.54	48.62±2.76	50.17±2.62	50.76±2.13
significant			N.S	N.S	N.S	N.S	N.S	N.S	N.S
control +			50.22±1.51 a	59.86±0.81 a	60.54±1.02 a	60.10±0.85 a	59.22±0.76 a	59.07±0.84 a	58.17±0.74 a
control -			36.71±3.08 b	32.61±2.35 b	27.59±1.85 b	20.24±1.68 b	15.40±2.27 c	18.76±2.28 b	25.22±1.90 b
Amino acids mixture	1%		47.94±2.15 a	61.09±0.64 a	59.92±0.57 a	57.40±0.42 a	55.35±0.72 b	55.99±0.85 a	56.28±0.51 a
	1.5%		50.73±1.94 a	59.23±0.85 a	59.17±0.55 a	57.78±0.65 a	55.82±0.70 ab	57.49±0.61 a	56.70±0.54 a
	2%		48.52±2.71 a	58.82±1.04 a	60.19±0.66 a	57.54±1.34 a	56.63±0.60 ab	58.11±0.70 a	56.63±0.80 a
significant			**	**	**	**	**	**	**
control +		T1	50.22±2.21 a	59.86±1.19 a	60.54±1.49 a	60.10±1.24 a	59.22±1.11 a	59.07±1.24 a	58.17±1.08 a
control -		T2	36.71±4.52 b	32.61±3.44 b	27.59±2.71 b	20.24±2.46 b	15.40±3.33 b	18.76±3.33 b	25.22±2.78 b
16%	1%	T3	44.77±3.95 ab	62.12±0.60 a	60.79±0.70 a	57.53±0.39 a	55.60±0.94 a	55.89±1.24 a	56.12±0.76 a
16%	1.5%	T4	50.01±2.55 a	59.27±1.23 a	59.22±0.80 a	57.60±0.82 a	55.57±1.20 a	57.22±0.88 a	56.48±0.80 a
16%	2%	T5	49.33±4.79 a	58.79±1.80 a	60.31±0.92 a	55.96±2.20 a	55.94±0.80 a	57.04±1.27 a	56.23±1.52 a
control +		T6	50.22±2.21 a	59.86±1.19 a	60.54±1.49 a	60.10±1.24 a	59.22±1.11 a	59.07±1.24 a	58.17±1.08 a
control -		T7	36.71±4.52 b	32.61±3.44 b	27.59±2.71 b	20.24±2.46 b	15.40±3.33 b	18.76±3.33 b	25.22±2.78 b
15%	1%	T8	51.11±1.18 a	60.05±1.04 a	59.05±0.82 a	57.26±0.77 a	55.11±1.15 a	56.09±1.24 a	56.45±0.72 a
15%	1.5%	T9	51.45±3.10 a	59.18±1.25 a	59.12±0.80 a	57.97±1.06 a	56.07±0.80 b	57.75±0.91 a	56.92±0.77 a
15%	2%	T10	47.71±2.90 a	58.84±1.19 a	60.07±1.02 a	59.13±1.48 a	57.32±0.88 a	59.18±0.43 a	57.04±0.64 a
significant			*	**	**	**	**	**	**

• Different letters within one column are significantly different at (P<0.05) or (P<0.01).

Feed consumption rate: The results in Table 5. show that there were significant differences (P<0.05) in the interaction study for protein percentages (16.15%) for the periods (first, second, sixth, and general rate) in favor of the treatment of reducing the protein percentage by 15%, while a significant decrease in the rate was observed. The feed consumed for the 16% protein reduction treatment, while the results showed that there were no significant differences for the periods (third, fourth, and fifth) among them in the rate of feed consumed for the diets reduced in the crude protein percentage by (15.16%). when studying the interaction in the rates of adding a mixture of essential amino acids in the rate of feed consumed (g), the results showed that there were significant differences (P<0.05) in the general rate in favor of the comparison treatment (standard diet), as the amount of the average feed consumed for the periods 21-44 weeks (626.86 g/bird) compared to the second treatment (a diet devoid of protein concentrate) and two diets adding an amino acid mixture at a rate of (1,1.5%). The first comparison treatment did not differ significantly from the treatment adding a mixture. amino acids (2%). As for the data for the experimental treatments, it showed that there were significant differences (P<0.05) in the overall rate in favor of the first treatment T1 (standard diet) compared to the treatments (T2, T3, T4 and T8), and the T1 treatment did not differ significantly (P<0.05) with each of (T5, T9 and T10) in feed consumption rate.

Feed conversion efficiency: The data in table 6. indicate the effect of withdrawing the protein concentrate, reducing the crude protein in the diets, and supplementing them with a mixture of essential amino acids on the rate of feed conversion efficiency for six periods 21-44 weeks, as the results showed that there were no significant differences in the interaction of protein ratios 15,16% for all periods and the general rate. As for the interaction in the rate of adding a mixture of essential amino acids, the results showed a significant improvement in the feed conversion efficiency in favor of the control treatment (standard diet) and the treatments of adding a mixture of amino acids (1, 1.5, 2%) compared to the control treatment. without protein concentrate for all periods and the general rate. As for the experimental parameters, the results showed a significant improvement for treatment (T1, T3, T4, T5, T8, T9, T10) compared to treatment T2, for all durations and the general rate.

Body weight (g/hen)

The results in Table 7. indicate that there are no significant differences in the interaction study of protein percentages (15 and 16%) between the two periods and their weight gain. When studying the interaction in the rates of adding a mixture of essential amino acids in the average body weight (g/hen), the results showed a significant superiority (P<0.05) when measuring weight at the beginning of the experiment in favor of the negative control treatment T2 compared to the treatment The positive control T1 and the two treatments adding a mixture of amino acids at a rate of (1.5 and 2%) did not differ significantly with the treatment adding a mixture of amino acids at a rate of 1%. When measuring the final weight of the birds, the results showed that T1 was significantly superior (P<0.05) compared to T2 when did not differ significantly from the treatments of adding a mixture of amino acids at a rate of (1 and 2%). As for the weight gain, the moral superiority was (P<0.05) in favor of the two treatments T1 and the treatment of adding a mixture of amino acids at a rate of 2%), as they reached the weight gain (289.25 and 252.78 g).

Table 5. The effect of withdrawing the protein concentrate and reducing the crude protein in the diets and supplementing them with a mixture of essential amino acids on Feed consumption rate (g)for six periods of 21-44 weeks for laying hens. (mean ± standard error)

Feed consumption rate (g/hen)								
influencing factors		1 21-24	2 25-28	3 29-32	4 33-36	5 37-40	6 41-44	1-6 21-44
protein ratio	16%	96.83±0.35 b	95.62±1.62 b	95.98±1.58	98.89±1.31	106.04±1.10	105.93±0.98 b	599.32±6.77 b
	15%	97.47±0.39 a	96.13±1.62 a	96.42±1.59	99.33±1.35	105.51±1.06	107.06±1.08 a	601.94±6.91 a
significant		*	*	N.S	N.S	N.S	*	*
control +		96.98±0.39 c	103.60±0.21 a	101.00±0.17 a	104.48±0.10 a	109.95±0.32 a	110.82±0.25ab	626.86±0.47 a
control -		93.16±0.08 d	76.04±0.32 d	76.58±0.36 c	82.68±0.37 d	93.09±0.76 c	94.68±0.39 d	516.26±1.61 d
Amino acids mixture	1%	97.86±0.35 b	97.93±0.51 c	100.09±0.59 b	102.26± 0.31c	107.62±0.64 b	105.17±0.31 c	610.96±1.49 c
	1.5%	98.63± 0.23 a	100.91±0.22b	101.66±0.28 a	103.06± 0.41b	108.77±0.63 ab	110.35±0.40 b	623.41±0.55 b
	2%	99.13± 0.15 a	100.90±0.22b	101.67±0.29 a	103.07± 0.26b	109.43±0.37 a	111.46±0.48a	625.69±0.60 ab
significant		*	*	*	*	*	*	*
control+	T1	96.98±0.57 c	1.3.60±0.30 a	101.00±0.26 b	104.48±0.14 a	109.95±0.47 a	110.82±0.36 b	626.86±0.70 a
control -	T2	93.16±0.12 d	76.04±0.47 e	76.58±0.53 e	82.68±0.45 e	93.09±1.12 c	94.68±0.57 e	516.26±2.37 e
%16 1%	T3	97.17±0.12 c	96.43±0.61 d	98.02±0.41 d	103.15±0.23 bc	106.63±0.86 b	104.74±0.20 d	606.15±1.27 d
%16 1.5%	T4	97.98±0.33 bc	100.73±0.37b	101.77±0.50 abc	101.95±0.31 d	110.78±0.33 a	109.12±0.38 c	622.36±0.74 b
%16 2%	T5	98.86±0.26 ab	101.32±0.31b	102.53±0.35 a	102.20±0.21 cd	109.76±0.52 a	110.29±0.68 bc	624.98±0.39 ab
control +	T6	96.98±0.57 c	1.3.60±0.30 a	101.00±0.26 b	104.48±0.14 a	109.95±0.47 a	110.82±0.36 b	626.86±0.70 a
control -	T7	93.16±0.12 d	76.04±0.47 e	76.58±0.53 e	82.68±0.45 e	93.09±1.12 c	94.68±0.57 e	516.26±2.37 e
15% 1%	T8	98.55±0.35 ab	99.44±0.30 c	102.15±0.34 ab	101.37±0.38 d	108.62±0.85 ab	105.61±0.56 d	615.76±1.16 c
15% 1.5%	T9	99.27±00.9 a	101.10±0.27b	101.55±0.32 abc	104.17±0.54 ab	106.77±0.69 b	111.57±0.37 a	624.46±0.76 ab
15% 2%	T10	99.40±00.9 a	100.48±0.26cb	100.81±0.18 c	103.94±0.36 ab	109.11±0.55 a	112.63±0.38 a	626.39±1.13 ab
significant		*	*	*	*	*	**	*

• Different letters within one column are significantly different at (P<0.05) or (P<0.01

respectively compared to the negative control treatment T2, which recorded (-192.56) g/hen. As for the experimental treatments, the results when measuring the average body weight at the end of the experiment compared to the beginning of the experiment for all treatments showed a significant superiority (P<0.05) in favor of the treatment (T1, T3, T4, T5, T8, T9 and T10) compared to the positive control treatment devoid of the protein concentrate, as Treatments (T1 and T10) recorded the highest average body weight (2030 and 1994.56 g/hen), respectively, meaning that their average weight gain was (289.25 and 270.88 g/hen), respectively.

Table 6. The effect of withdrawing the protein concentrate and reducing the crude protein in the diets and supplementing them with a mixture of essential amino acids on Feed conversion efficiency for six periods of 21-44 weeks for laying hens. (mean ± standard error

Feed conversion efficiency									
influencing factors			1 21-24	2 25-28	3 29-32	4 33-36	5 37-40	6 41-44	1-6 21-44
protein ratio	16%		2.26±0.11	1.86±0.09	1.94±0.10	2.33±0.19	3.16±0.48	2.76±0.34	2.39±0.20
	15%		2.17±0.39	1.88±0.09	1.96±0.10	2.31±0.19	3.14±0.48	2.76±0.34	2.37±0.20
significant			N.S	N.S	N.S	N.S	N.S	N.S	N.S
control +			1.96±0.06 b	1.37±0.02 b	1.67±0.03 b	1.74±0.02 b	1.86±0.02 b	1.88±0.03 b	1.81±0.02 b
control -			2.84±0.24 a	2.61±0.26 a	3.00±0.24 a	4.49±0.33 a	8.07±1.02 a	6.23±0.73 a	4.54±0.40 a
Amino acids mixture	%1		2.11±0.11 b	1.60±0.02 b	1.67±0.02 b	1.78±0.01 b	1.94±0.02 b	1.88±0.02 b	1.83±0.02 b
	%1.5		1.99±0.09 b	1.70±0.02 b	1.72±0.01 b	1.78±0.02 b	1.95±0.02 b	1.92±0.02 b	1.84±0.02 b
	%2		2.18±0.17 b	1.72±0.03 b	1.69±0.01 b	1.80±0.04 b	1.93±0.02 b	1.92±0.02 b	1.87±0.04 b
significant			*	*	*	*	*	*	*
control +		T1	1.96±0.09 b	1.37±0.03 b	1.67±0.04 b	1.74±0.03 b	1.86±0.04 b	1.88±0.04 b	1.81±0.04 b
control -		T2	2.84±0.35 a	2.61±0.39 a	3.00±0.35 a	4.49±0.49 a	8.07±1.50 a	6.23±1.07 a	4.54±0.59 a
16%	1%	T3	2.30±0.21 ab	1.55±0.01 b	1.61±0.02 b	1.79±0.01 b	1.92±0.03 b	1.88±0.04 b	1.84±0.03 b
16%	1.5%	T4	2.00±0.11 b	1.70±0.04 b	1.72±0.02 b	1.77±0.02 b	2.00±0.04 b	1.91±0.03 b	1.85±0.02 b
16%	2%	T5	2.22±0.32 b	1.37±0.05 b	1.70±0.02 b	1.85±0.08 b	1.96±0.02 b	1.94±0.05 b	1.90±0.08 b
control +		T6	1.96±0.09 b	1.37±0.03 b	1.67±0.04 b	1.74±0.03 b	1.86±0.04 b	1.88±0.04 b	1.81±0.04 b
control -		T7	2.84±0.35 a	2.61±0.39 a	3.00±0.35 a	4.49±0.49 a	8.07±1.50 a	6.23±1.07 a	4.54±0.59 a
15%	1%	T8	1.93±0.04 b	1.65±0.02 b	1.73±0.02 b	1.77±0.02 b	1.97±0.03 b	1.88±0.04 b	1.82±0.02 b
15%	1.5%	T9	1.99±0.16 b	1.71±0.03 b	1.71±0.02 b	1.80±0.03 b	1.90±0.03 b	1.93±0.02 b	1.84±0.03 b
15%	2%	T10	2.14±0.14 b	1.71±0.03 b	1.68±0.03 b	1.76±0.04 b	1.90±0.03 b	1.90±0.01 b	1.85±0.02 b
significant			*	*	*	*	*	*	*

• Different letters within one column are significantly different at (P<0.05) or (P<0.01).

The results in Table 2. indicate that there are significant differences (P<0.05) between the treatments, periods, and the general rate of the experiment in egg production percentage (H.D%). It was noted that there are no significant differences between the treatments for the first period of the experiment, The reason may be due to the inability of laying hens to adapt to the sudden changes in the diet at the beginning of the first productive period, but soon there is an adaptation to diets with a reduced protein level and fortified with a mixture of amino acids that worked to influence the productive traits in a positive way.

Table 7. The effect of withdrawing the protein concentrate and reducing the crude protein in the diets and supplementing them with a mixture of essential amino acids on Average body weight and weight gain(g/hen)for six periods of (21-44) weeks for laying hens for six periods of 21-44 weeks. (mean ± standard error)

Average body weight (g/hen)					
influencing factors			The experiment began at 21weeks of age	End of the experiment at 44 weeks	Weight gain
protein ratio		16%	1777.81±16.16	1922.23±26.76	144.41±33.95
		15%	1769.08± 18.19	1910.74±25.11	144.66±34.41
significant			N.S	N.S	N.S
control +			1740.75± 24.34 b	2030±13.01 a	289.25±18.29 a
control -			1843.81± 22.80 a	1651.25± 37.07 c	-192.56±35.84 c
Amino acids mixture		1%	1787.06± 29.16 ab	1980.53±17.82 ab	193.46± 32.76 ab
		1.5%	1763.50± 27.84 b	1935.75± 22.12 b	172.25±38.40 b
		2%	1732.09± 24.16 b	1984.88± 16.01ab	252.78± 32.58 ab
significant			**	*	*
control +		T1	1740.75±35.63 ab	2030±19.04 a	289.25±26.78 a
control -		T2	1833.25±27.97 a	1651.25±54.26 b	-182.00±52.11 b
16%	1%	T3	1769.88±41.99 ab	2006.31±29.14 a	236.44±42.10 a
16%	1.5%	T4	1804.69±45.51 ab	1948.38±37.86 a	143.69±64.98 a
16%	2%	T5	1740.50±21.09 ab	1975.19±26.61 a	234.69±45.82 a
control +		T6	1740.75±35.63 ab	2030±19.04 a	289.25±26.78 a
control -		T7	1833.25±27.97 a	1651.25±54.26 b	-182.00±52.11 b
15%	1%	T8	1804.25±42.40 ab	1954.75±18.00 a	150.50±47.95 a
15%	1.5%	T9	1722.31±27.70 b	1923.13±24.86 a	200.81±43.19 a
15%	2%	T10	1723.69±45.13 b	1994.56±19.10 a	270.88±48.54 a
significant			*	*	*

• Different letters within one column are significantly different at ($P<0.05$) or ($P<0.01$).

When the general rate is observed, it is evident that there were no significant differences between the crude protein reduction treatments (15 and 16%) supplemented with an amino acid mixture and the comparison treatment T1 (standard diet), while those treatments differed with the comparison treatment T2 (free of protein concentrate). this means that the lower level of crude protein (15, 16%) met the birds' need for crude protein to maintain egg production, which did not differ significantly in the egg production of birds fed a diet with the highest level of crude protein (17%). Researchers (16,30,40) indicated that the level of crude protein in the diet did not affect the level of egg production, while (22) indicated that increasing the percentage of crude protein in the diet led to a significant increase in the rate of egg production. The significant improvement between the treatments for reducing protein content in the level of egg production may be due to supporting these diets with a mixture of essential amino acids (methionine, lysine, and threonine). These are considered the specific amino acids in the first, second, and third poultry diets, respectively (6,8,22), and adding them to poultry diets leads to many important functions in enzyme reactions and protein synthesis (12), and supplementing diets with these amino acids improves the productive performance of laying hens and improves the quality characteristics of the egg (5) and prevents the negative effects resulting from an imbalance in the resulting amino acids. From using reduced diets, the level of crude protein is less than (14%) (29). It was noted from the results in table 3. that there were significant differences ($P<0.05$) in the average egg weight (g) between all experimental treatments and for all periods, which showed that the treatments for reducing the percentage of crude protein at the level of (15, 16%) fortified with a mixture of amino acids did not differ significant differences between it and the control treatment (standard diet). This result indicates the role of essential amino acids in supporting these diets and meeting the bird's needs for essential amino acids, these acids have important roles, as methionine has multiple roles, as considered essential amino acids for protein synthesis, it is characterized by being a donor of the methyl group through the process of transmethylation, which contributes to the synthesis of many compounds such as creatine, carnitine, betaine, cysteine, homocysteine, and choline, It is a donor to the sulfur atom through the process of transsulfuration to contribute to the formation of amino acids that contain the sulfur element in their chemical structure, such as glutathione (GSH), taurine (16,22), and methionine also affects the relative weight of the ovary, the length of the oviduct, the total number of large and small follicles in the ovarian cluster, and the growth and maturation rate of secondary follicles (10), and its deficiency leads to an imbalance in the nutritional metabolism of fats and proteins, which reduces the production and quality of eggs, causes disturbances in the ovulation process and liver function, and causes obesity (18). The improvement may be due to the role of the amino acids (methionine, lysine, and threonine) in stimulating the production of gonadotropin-stimulating hormones (GnRH) (10,36). This in turn leads to an increase in the secretion of FSH and LH, which in turn helps stimulate the growth of ovarian follicles and stimulate the ovulation process (13,37). Researchers noted that there was a significant improvement in the average weight of eggs by increasing the percentage of crude protein in the diet (15,19), while (40) indicated an improvement in the average weight of eggs when the percentage of protein was reduced and the diet was supplemented with a mixture of the amino acids methionine and lysine. The data in table 4. for egg mass characteristic showed that there were significant differences ($P<0.05$) between all experimental treatments and for all periods, as we note a deterioration in egg mass for the comparison treatment T2 (a diet devoid of protein concentrate), and this is evidence of a decrease in its egg production rate, which had a negative impact in egg mass, egg mass is a natural reflection of the number and weight of eggs produced. As for the rest of the experimental treatments, they did not differ significantly ($P<0.05$) from each other, as we note that there are no significant differences between the treatments for reducing protein percentage supplemented with a mixture of amino acids with the positive control treatment T1 as we note that the mass of eggs increases as the bird aged, and as the number of eggs and their weight increase linearly as the chicken grows older within the peak of production, which positively affects egg mass. Researchers (15,27) indicated that there are significant differences in egg mass depending on the level of crude protein in the diet. The reason of no significant differences between the protein-reducing treatments fortified with a mixture of amino acids and the comparison treatment (standard diet) may be is due to no significant differences ($P<0.05$) in the egg production rate and egg The weight rate is among these parameters, as the egg mass results from the product of the egg production rate divided by the egg weight rate. The high economic income is the determining factor for the efficiency of good production performance, and it is only a reflection of balanced nutrition and the amount of benefit from it. The indicator of the amount of feed consumed is evidence of the good nutritional content of the feed provided to the birds and its efficiency, as can be seen from table 5. of the data related to the averages of feed consumed, it was noted that deterioration in treatment T2 (diet without protein concentrate). The rest of the experimental treatments, represented by treatments reducing the percentage of protein (15, 16%) supplemented with a mixture of amino acids at a rate of (1, 1.5, and 2%), no significant differences were observed ($P<0.05$) compared to the control treatment (commercial diet). This is evidence that the bird is meeting its needs for the necessary nutrients to meet its needs for the purpose of production and sustainment and that the amino acid threonine has an important role in the formation of the mucous layer that surrounds the epithelial layer of the digestive tract, as it is included in The formation of myosin in epithelial tissue, which is the basic intestinal barrier or the first line of defense for maintaining the digestive system by strengthening the immune system through the secretion of immunoglobulins (37), Studies indicate that a diet fortified with threonine is necessary to maintain immune functions in the digestive tract (42,43), as well as its role in the process of digestion and absorption, increasing the thickness of this layer, increasing the length of the villi and the depth of the crypts, and increasing the number of goblet cells, causing an increase in mucus, which in turn improves digestion processes by influencing the speed of passage of the food mass into the digestive canal and increasing the benefit from the digested nutrients (23). Reducing the level of crude protein and adding amino acids will greatly increase the efficiency of utilizing food protein, meaning that the birds have adapted to the amount of crude protein available in that diet, and the bird will benefit from the amino acids fortified in that diet, which will reflect positively on the birds' performance, as indicated by (29). The addition of methionine and lysine leads to prevent the negative effects resulting from the imbalance of amino acids resulting from the use of diets with reduced protein levels less than (14%). As shown in table 6. for the feed conversion factor, there was a significant superiority ($P<0.05$) for the protein reduction treatments fortified with a mixture of amino acids, which did not differ significantly from T1 (standard diet). This improvement may be due to the role of amino acids that led to the benefit from crude protein, which made a significant improvement in raising the efficiency of feed conversion, which had a positive impact on the bird. table 7. includes the live body weight and the changes occurring in the body weight, as it was observed that there was a deterioration in the body weight for the first period at the beginning of the experiment, but at the end of the experiment it was observed that there was a significant superiority ($P<0.05$) in favor of all the experimental treatments except for a deterioration in negative comparison (diet devoid of protein concentrate), and the significant superiority ($P<0.05$) is the result of nutritional adaptation in which the body controls the metabolic processes in a way that meets its actual need for maintenance and production, and that benefiting from the positive effect of supplements of the mixture of amino acids added to the diet It appears effectively when the percentage of protein in the diets provided to the bird is reduced, as it was observed that diets was achieved in most of the characteristics between the comparison diet and the diet with a 2% amino acid mixture, which indicates that the diets containing 17% protein did not differ in their production characteristics from the diets that contained protein. 15% raw, but the effect of the mixture of functional amino acids worked to fill this deficiency in the percentage of protein and adequately supported what the bird needed.

Conclusion

From the results that included some of the productive traits studied in the experiment, it can be concluded that the treatments for adding a mixture of amino acids gave positive results, as the interference in the protein percentage did not have a significant effect on the traits studied above, and that reducing the protein percentage by 1% and 2% was compensated by adding the mixture of essential amino acids methionine, lysine and threonine, which in turn helped the bird meet its needs for essential amino acids, which leads to prevent the negative effects resulting from the imbalance of amino acids which caused from the use of low-level crude protein diets. Therefore, we conclude that it is possible to replace commercial protein concentrate and add an alternative one, contains a mixture of synthetic amino acids that provides economical importance.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

DECLARATION OF FUND

The authors declare that they have not received a fund.

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