J. Product. & Dev., 27(4): 443- 462 (2022)

EFFECT OF LOW DIETARY CRUDE PROTEIN , METABOLIZABLE ENERGY AND IDEAL LEVELS OF AMINO ACIDS ON CARCASS CHARACTERISTICS AND SOME METABOLIC RESPONSE OF BROILERS.

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ABSTRACT

This study was conducted to determine the response to low dietary crude protein and energy while supplementing ideal amino acids level on carcass characteristics and some metabolic response of broiler chicks. At one day old, 270 chicks randomly divided to 6 groups each with 45 chicks and 3 replicates of 15 birds as follows; T1: positive control (PC) with basal diet (BD) with recommended CP level and ME, T2: negative control (NC) fed BD with reduce 3% CP and 100 kcal than requirements); T3 and T4 were fed BD diet (reduce 3% CP) but supplemented incrementally with four and five AAs (Lys, Met, Thr, Trp and valin, respectively); T5 and T6 were fed NC but supplemented incrementally with four and five AAs (Lys, Met, Thr, Trp and valin, respectively). From 1 to 35 d of age, to cover the dietary requirements for each AA during periods.

***Results showed that** treatment applied had highly significant effect on absolute weight (AW) of carcass, liver and abdominal fat and relative weight (RW) of carcass, heart and gizzard, respectively. Birds of treatment (1) and (6) had the higher average of AW of carcass (1565.0 and 1465.0g) while RW of abdominal fat (0.0109 and 0.011%, respectively) compared with different treatments applied. Birds of treatment (2) and (4) showed the lowest AW, RW of abdominal fat (8.33,11.67g and 0.0057,0.0065%, respectively). Treatments applied had significant effect on plasma globulin , A/G ratio, ALT and AST all period. Birds of Treatment (6) had the higher average of plasma total protein (TP) (3.80 mg/dl) and globulin (1.91mg/dl) and lowest average of creatinine.. However T4, T1 showed the higher average of TG and VLDL (25.00, 24.00 mg/dl) and (5.00, 4.80 mg/dl, respectively).*

***Conclusively, i**t can be recommended by decreasing CP 3 % and ME 100 kcal/kg diet without affecting carcass characteristics and* *metabolic response with supplemental (Lys, Met, Thr, Trp, and Val) to obtain the best performance of broiler diets.*

Key words: Broilers, Low crude protein, Low energy, Amino acids, Metabolic response.

INTRODUCTION:

Feed in poultry production accounts for more than 70% of the total production cost. Therefore, it was important to discover strategies to improve feed efficiency through better feeding and appropriate selection of ingredients without affecting the economic impact. Better feed efficiency is also associated with less impact on the environment. Calculating feed efficiency means recording the amount of feed intake and growth. Improving feed composition is a key factor in improving animal health and welfare, as well as increasing livestock productivity. Essential amino acids (EAA) are amino acids that cannot be made by the body and must be obtained from the diet. **(Jian *et al.*, 2021).**

High crude protein in chicken feed leads to an increase in amino acids and an increase in nitrogen excretion. The efficiency of nitrogen retention can be improved when low CP broiler diets are supplemented with crystalline amino acids in a manner that meets the needs of growing tissues. Reducing crude protein in the diet reduces nitrogen use efficiency, reduces nitrogen excretion, improves poultry tolerance to high ambient temperatures and reduces ammonia levels in the litter **(Shirisha *et al.*, 2018**). On the other hand, **Sacranie *et al*., (2012)** reported that, diet reduction had no significant effect on the carcass and heart weight ratio, but it led to a significant increase in the alveoli weight ratio.

Recently, threonine has been identified as the third identified amino acid in most poultry plant feeds. Due to the increasing use of lysine and methionine in broiler breeding, it has been considered as an important factor affecting poultry performance **(Shirisha *et al.*, 2018)**. **Chen *et al.*, (2016)** stated that amino acid availability is crucial for optimal growth, especially muscle growth, as well as physiological function in commercial chicken breeds due to their rapid growth. Increasing dietary ME significantly increased body weight gain, abdominal fat, liver weights, and protein and fat contents of the carcass while carcass dry matter was reduced by increasing the dietary ME.**(Zaman *et al*., 2008).**

Many reports indicated the incidence of high body fat deposition when broilers are fed on low-CP and **Hada *et al.*, (2013**) reported that carbohydrate metabolism in broiler chickens was not affected by CP and ME levels in the diet. This may be due to the strict regulation of carbohydrate metabolism in the same birds to maintain the level of glucose in the blood. Blood components may be influenced by physiological factors, such as age and species, and by pathological factors **(Szabo *et al*., 2005).**

The determination of blood component values using laboratory exams is an important procedure to aid the diagnosis of several diseases and dysfunctions, as they provide reliable results, and may also give inputs for research studies on nutrition, physiology, and pathology **(Bounous et al., 2000).**

Therefore, the main objective of the current trial was to investigate the impact of adding ideal level of amino acids to low-CP and low-ME diets on carcass characteristics and some biochemical parameters of broiler chickens**.**

MATERIALS AND METHODS

The experimental work of the present study was carried out at private poultry farm at Moshtohor, El Qalubyia Governorate, Egypt during the period from 10th December, 2021 to 13th of January, 2022.

Birds and their management:

A total number of 270 one-day-old Arbor Acres broilers similar in live body weight (42.11 ± 3.77 g) were obtained from the commercial hatchery of Cairo Poultry Company (10th Ramadan City, Egypt),chickens were reared according to technological and recommendation for this strain. Chicks were kept under similar standard hygienic and environmental conditions in separate pens with 15 birds/m^2 stoking density until the end of the experiment. Wood shaving was used at 10 cm depth as a litter. Brooding temperature was maintained at 35˚C during the first 5 days of chicks age, then decreased by 2˚C weekly until the end of the 5th week.

Feed and water were offered *ad-libitum*. The lighting program was 24h light during the first 5 days of age, then from 6 to 35 days of the age (the end of the experiment) 23h light and 1h dark was applied. Chicks were fed starter, grower and finisher diets. The basal diet was formulated according to the recommended requirements of **NRC (1994)** as shown in Tables 1,2 and 3.

Experimental design :

A total number of 270 one-day-old Arbor Acres broilers were used in this study chicks were randomly divided into sex experimental groups each of 45 chicks in 3 replicates (15 chick /each).The experimental treatments were shown as the following:

T1: Fed Basal diets (Bd) with recommended levels of CP and ME (control group)
T2: Fed Bd reduce by 3% CP and 100 kcal ME than recommendation.
T3: Fed Bd with reduce 3 % CP and recommended ME supplemented with four AAs (Lys, Met, Thr and Trp).
T4: Fed Bd with reduce 3% CP and recommended ME supplemented with five AAs (Lys, Met, Thr, Trp and Val).
T5: Fed Bd with reduce 3% CP and 100 kcal ME than recommendation supplemented with four AAs (Lys, Met, Thr and Trp).

T6: Fed Bd with reduce 3% CP and 100 kcal ME than recommendation supplemented with five AAs (Lys, Met, Thr, Trp and Val).

Measurements:

1. ***Carcass Characteristics:***

Carcass characteristics for random sample of birds from each experimental group were performed at the end of the experimental period. Birds chosen were deprived from feed for 16 hours, individually weighted to the nearest g and slaughter by cutting the throat and the jugular veins and carotid artery with a sharp knife near the first neck vertebra .Birds were reweighted individually after complete bleeding ,shank and head were separated, the birds were eviscerated and intestine, gizzard, lungs, spleen, liver, heart and all internal organs were removed.

The carcass and giblets (empty gizzard, liver and heart)were separately weighted. The proportional weights to live weight of giblets, carcass and total edible parts were calculated. Absolute and relative weights of abdominal fat were also calculated

Abdominal Fat percentage(%)=Abdominal fat weight (g)/Pre slaughter live weight (g)×100

Giblets Weight: The giblets (heart, liver and empty gizzard) were cleaned and weighed. The organ weights were expressed as percent of pre-slaughter live weight as shown below:

Giblets Weight (%) = Weight of organ (g) / Pre slaughter live weight (g) **×**100

2. ***Plasma Biochemical Parameters:***

The blood samples for plasma biochemical analyses were collected from 6 birds in each treatment at the end of the growth of experiment. The blood was collected up on slaughtering in heparinized tubes and subject to centrifugation at 3000 rpm for 10 minutes. The activities of the enzymes gamma-glutamyltransferase (modified Szasz' method), aspartate aminotransferase ,ALT, AST (Reitman-Frankel' method), creatinine (Basques-Lustosa's method), triglycerides (Trinder's enzymic method), , albumin (bromocresol green method), total protein (biuret method), urea (Trinder's enzymic method) and Glucose. Plasma globulin value was calculated by subtracting the value of albumin level from the value of total protein level. A/G ratio was calculated by divided direct albumin level by globulin, VLDL was calculated by divided direct TG/5 (Friede Wald et al.1972). Samples reading were performed using spectrophotometry (LABQUEST semi-automatic spectrophotometer,5010) with light wave length adequate for each test. The plasma samples were analyzed immediately to the laboratory after finishing the process using clinical auto analyzer.

Table 1: Ingredients and chemical of the basal diets used in starter periods(1-10 days).

Ingredients	**Experimental groups**					
	T_1	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**
Yellow corn	55.35	63.2	61.20	61.20	63.42	63.40
Soybean meal (44%)	31.0	29.8	30.1	30.1	30.1	30.0
Corn Gluten (60%)	7.4	3.3	2.0	1.8	1.8	1.70
Soya Oil	1.87	-	2.0	2.0	-	-
Di Calcium Phosphat.	1.85	1.85	1.85	1.86	1.86	1.86
Calcium Carbonate	1.15	1.15	1.14	1.14	1.14	1.14
L-lysine	0.33	-	0.40	0.40	0.39	0.40
DL-methionine	0.26	-	0.41	0.41	0.40	0.41
L. tryptophan	-	-	0.02	0.02	0.02	0.02
L-threonine	0.06	-	0.18	0.18	0.17	0.19
L-valine	0.03	-	-	0.19	-	0.18
Vit &Min. premix*	0.30	0.30	0.30	0.30	0.30	0.30
Choline Chloride (60%)	0.01	0.01	0.01	0.01	0.01	0.01
Common salt	0.30	0.30	0.30	0.30	0.30	0.30
Sodium bicarbonate	0.10	0.10	0.10	0.10	0.10	0.10
Total	**100**	**100**	**100**	**100**	**100**	**100**
Calculate analysis*						
CP (%)	23.00	20.0	20.0	20.0	20.0	20.0
ME (Kcal/kg)	3003	2900	3006	3006	2902	2906
C F	3.48	-	3.48	3.48	3.35	3.52
E E	4.39	-	4.60	4.61	2.70	3.83
Ca (%)	1.01	1.01	1.01	1.01	1.01	1.01
Avail Ph (%)	0.48	0.48	0.48	0.48	0.48	0.48
L-lysine (%)	1.45	1.06	1.45	1.45	1.45	1.45
Methionine(%)	1.08	0.71	1.08	1.08	1.08	1.08
Treptophan(%)	0.23	0.22	0.23	0.23	0.23	0.23
Threonine (%)	0.97	0.82	0.97	0.97	0.97	0.97
Valine(%)	1.11	0.97	0.93	1.11	0.92	1.11

*Each 3Kg of Vitamin. and Minerals Premix contains: Vit A12000000 IU, Vit D3 2200000 IU, Vit E 10000 mg, Vit B1 1000 mg, Vit B2 5000 mg, Vit B6 1600 mg, Vit B12 10 mg, Niacin-30000 mg, Calcium-D-Pantothenic acid 10000 mg, Biotin-50 mg, Folic Acid-1000 mg and Choline 250000 mg,Vit-K-4000mg , antioxidant,10g,. Trace mineral mixture: Iron 30000 mg, Iodine 1000 mg, Copper 10000 mg, Manganese 60000 mg, Zn 50000 mg, Selenium 100 mg, Cobalt 100 mg, and carrier (Calcium Carbonate) up to 3kg., According the Egyptian Regional Center for Food and Feed (RCFF,2001)

T1: Fed Basal diets (Bd) with recommended levels of CP and ME (control group), **T2:** Fed Bd reduce by 3% CP and 100 kcal ME than recommendation, **T3:** Fed Bd with reduce 3 % CP and recommended ME supplemented with four AAs (Lys, Met, Thr and Trp), **T4:** Fed Bd with reduce 3% CP and recommended ME supplemented with five AAs (Lys, Met, Thr, Trp and Val), **T5:** Fed Bd with reduce 3% CP and 100 kcal ME than recommendation supplemented with four AAs (Lys, Met, Thr and Trp), **T6:** Fed Bd with reduce 3% CP and 100 kcal ME than recommendation supplemented with five AAs (Lys, Met, Thr, Trp and Val).

Table (2): Ingredients and chemical analysis of grower diets (11-25 d).

Ingredients	Experimental groups					
	T_1	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**
Yellow corn	58.70	67.55	63.07	63.07	65.49	65.19
Soybean meal (44%)	27.5	24.5	28.67	28.67	28.20	28.83
Corn Gluten (60%)	7.2	4.1	0.64	0.50	0.80	0.25
Soya Oil	2.78	0.50	3.50	3.50	1.40	1.50
Di calcium phosphate	1.65	1.68	1.66	1.66	1.65	1.65
Carbonate Calcium	0.95	0.97	0.96	0.96	0.98	0.96
L-lysine	0.27	-	0.29	0.29	0.29	0.28
DL-Methionine	0.22	-	0.38	0.38	0.37	0.38
L.treptophan	-	-	0.01	0.01	0.01	0.01
L-thrionine	0.03	-	0.12	0.12	0.11	0.11
L-valine	-	-	-	0.14	-	0.14
Vit &Min. premix*	0.30	0.30	0.30	0.30	0.30	0.30
Cholin Chioride (60%)	0.05	0.05	0.05	0.05	0.05	0.05
Common salt	0.30	0.30	0.30	0.30	0.30	0.30
Sodium bicarbonate	0.10	0.10	0.10	0.10	0.10	0.10
Total	**100**	**100**	**100**	**100**	**100**	**100**
Calculated analysis*						
CP (%)	21.5	18.50	18.50	18.50	18.50	18.50
ME (Kcal/kg)	3100	3000	3105	3104	3001	3001
C F	3.31	-	3.40	3.40	3.42	3.46
E E	5.38	-	6.10	6.10	4.12	4.20
Ca (%)	0.88	0.89	0.88	0.88	0.88	0.88
Avail Ph (%)	0.44	0.44	0.44	0.44	0.44	0.44
L-lysine (%)	1.29	0.93	1.29	1.29	1.29	1.29
Methionine(%)	1.0	0.68	1.0	1.0	1.0	1.0
Treptophan(%)	0.22	0.20	0.22	0.22	0.22	0.22
Threonine (%)	0.86	0.76	0.86	0.86	0.86	0.86
Valine(%)	1.01	0.9	0.87	1.01	0.87	1.01

*Each 3Kg of Vitamin and Minerals Premix contains: Vit.A 12000000 IU, Vit D3 2200000 IU, Vit E 10000 mg, Vit B1 1000 mg, Vit B2 5000 mg, Vit B6 1600 mg, Vit B12 10 mg, Niacin-30000 mg, Calcium-D-Pantothenic acid 10000 mg, Biotin-50 mg, Folic Acid-1000 mg and Choline 250000 mg,Vit-K-4000mg , antioxidant,10g,. Trace mineral mixture: Iron 30000 mg, Iodine 1000 mg, Copper 10000 mg, Manganese 60000 mg, Zn 50000 mg, Selenium 100 mg, Cobalt 100 mg, and carrier (Calcium Carbonate) up to 3kg.,

According the Egyptian Regional Center for Food and Feed (RCFF,2001)

See Abbreviations in below Table 1.

Table (3) : Ingredients and chemical of finisher diets (26-35 d).

Ingredients	Experimental groups					
	T_1	T_2	T_3	T_4	T_5	T_6
Yellow corn	70.60	70.63	68.39	68.39	70.6	60.0
Soybean meal (44%)	22.88	22.87	22.87	22.8	22.78	28.0
Corn Gluten (60%)	0.60	0.70	0.80	1.0	1.6	3.62
Soya Oil	2.00	2.00	4.00	4.00	2.0	5.0
Di calcium phosphate	1.43	1.43	1.43	1.43	1.42	1.40
Carbonate Calcium	0.9	0.9	0.9	0.9	0.9	0.9
L-lysine	0.31	0.31	0.31	0.31	-	0.15
DL-Methionine	0.34	0.34	0.34	0.34	-	0.22
L.treptophan	0.01	0.01	0.01	0.01	-	0.01
L-thrionine	0.11	0.11	0.12	0.12	-	-
L-valine	0.12	-	0.13	-	-	-
Vit &Min. premix*	0.30	0.30	0.30	0.30	0.30	0.30
Cholin Chioride (60%)	0.05	0.05	0.05	0.05	0.05	0.05
Common salt	0.30	0.30	0.30	0.30	0.30	0.30
Sodium bicarbonate	0.10	0.10	0.10	0.10	0.10	0.10
Total	**100**	**100**	**100**	**100**	**100**	**100**
CP (%)	19.50	16.5	16.5	16.5	16.50	16.50
ME (Kcal/kg)	3203	3100	3203	3204	3101	3103
E F	3.33	-	3.11	3.12	3.16	3.16
E E	7.54	-	6.77	6.76	4.86	4.86
Ca (%)	0.79	0.79	0.79	0.79	0.79	0.79
Avail Ph (%)	0.395	0.395	0.396	0.395	0.395	0.395
L-lysine (%)	1.16	0.86	1.16	1.16	1.16	1.16
Methionine(%)	0.91	0.60	0.91	0.91	0.91	0.91
Tryptophan(%)	0.22	0.18	0.19	0.19	0.19	0.19
Threonine (%)	0.79	0.69	0.78	0.78	0.78	0.78
Valine (%)	0.93	0.80	0.78	0.90	0.78	0.90

*Each 3Kg of Vitamin. and Minerals Premix contains: Vit A12000000 IU, Vit D3 2200000 IU, Vit E 10000 mg, Vit B1 1000 mg, Vit B2 5000 mg, Vit B6 1600 mg, Vit B12 10 mg, Niacin-30000 mg, Calcium-D-Pantothenic acid 10000 mg, Biotin-50 mg, Folic Acid-1000 mg and Choline 250000 mg,Vit-K-4000mg , antioxidant,10g,. Trace mineral mixture: Iron 30000 mg, Iodine 1000 mg, Copper 10000 mg, Manganese 60000 mg, Zn 50000 mg, Selenium 100 mg, Cobalt 100 mg, and carrier (Calcium Carbonate) up to 3kg.,

According the Egyptian Regional Center for Food and Feed (RCFF,2001)

See Abbreviations in below Table 1.

Statistical Analysis:

Data collected were subjected according to **Snedecor and Cochran, (1982)** using General Linear Model procedure of SAS users guide **(SAS, 2001).**

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

Where:

- Y_{ij} = An observation, - μ = Overall mean, -T_i = Effect of Ith treatments (i =1,…, 6), e_{ij} = Experimental error.

Differences between means were tested using Duncan's multiple range tests **(Duncan,1955).**One way analysis model was applied for experiment.

RESULTS AND DISCUSSION

Carcass Characteristics:

Data presented in Table 4 showed that treatment applied had significant effect on absolute weights of carcass ,liver and abdominal fat and relative weight of carcass, heart and gizzard weight, respectively. Birds of T1 showed the highest absolute and relative weight of carcass followed by birds of T6 which showed the highest absolute and relative weight of liver, gizzard and abdominal fat The higher percentage level of abdominal fat in T6 than all treatment could be due to decreasing dietary protein and energy which widened the calorie protein ratio resulting in higher energy intake relative to protein intake by supplemented amino acids **(Kidd *et al.*, 1996).**. This increase of energy intake might have been diverted towards fat synthesis and it is deposition in abdominal area, and may be due to the possibility that the lysine and methionine supplementation resulted in better utilization of energy towards body protein synthesis **(Antonia *et al.*, 1997).**.. However,T2 and T4 showed the lowest absolute and relative weight of abdominal fat (8.33,11.67g) and (0.0057,0.0065% respectively) when compared with different treatments applied. Birds of T4 showed increased absolute and relative weights of heart (10 g and 0.0055%, respectively) than the other treatment.

The results obtained in agreement with the findings of **Gonzalo** *et al.*, **(2022)** stated that the effect of a dietary energy reduction in different CP diets on carcass characteristics. Abdominal fat was significantly higher (+5%) only in CP-18, and breast meat (+2%) only in CP-17, compared to CP-19. For E, only E-2900 differed significantly from E-3200 in FI (+3%), BW (-3%), ADG (-5%), carcass dressing (+1%) and abdominal fat (-7%).

Reda *et al.*, (2015) did not show any significant effect on all carcass characteristics due to different dietary CP, ME and Lys or their interactions, except carcass percentage was higher in chicks fed diet contained 1.3% Lys dressing percentage was significantly ($p \leq 0.01$) influenced by CP and Lys levels.

Table (4): Effect of low dietary crude protein , metabolizable energy and ideal levels of amino acids on carcass characteristics.

Traits / Trt*	Carcass		Liver		Heart		Gizzard		Abdominal fat	
	(g)	(%)	(g)	(%)	(g)	(%)	(g)	(%)	(g)	(%)
T1	1565.00 [a] ±59.65	0.791 [a] ±0.0097	40.0 ±2.88	0.0202 ±0.0009	10.0 ±0.00	0.0051 ±0.0009	30.00 [b] ±0.00	0.0152 [c] ±0.0070	21.67 [a] ±3.33	0.0109 ±0.0015
T2	1041.67 [d] ±10.93	0.712 [b] ±0.0062	36.7 ±9.28	0.0249 ±0.0005	8.3 ±1.66	0.0057 ±0.0011	33.33 [ab] ±1.66	0.0228 [a] ±0.0009	8.33 [b] ±1.66	0.0057 ±0.0011
T3	1073.33 [d] ±40.96	0.706 [b] ±0.018	36.7 ±1.66	0.0241 ±0.008	6.7 ±1.66	0.0044 ±0.0011	30.00 [b] ±2.88	0.0197 [abc] ±0.0016	13.33 [ab] ±4.40	0.0088 ±0.0028
T4	1348.33 [bc] ±66.47	0.746 [ab] ±0.0334	40.0 ±0.00	0.0221 ±0.0001	10.0 ±2.88	0.0055 ±0.0016	30.00 [b] ±2.88	0.0166 [bc] ±0.0015	11.67 [ab] ±1.66	0.0065 ±0.0095
T5	1230.00 [cd] ±41.93	0.748 [ab] ±0.011	41.7 ±3.33	0.0253 ±0.0016	8.3 ±1.66	0.0050 ±0.0009	35.00 [ab] ±2.88	0.0214 [a] ±0.0021	15.00 [ab] ±0.00	0.0091 ±0.00018
T6	1465.00 [ab] ±100.04	0.781 [a] ±0.0181	58.3 ±7.26	0.0286 ±0.0028	10.0 ±0.00	0.0054 ±0.0002	38.33 [a] ±1.66	0.0205 [ab] ±0.0010	21.67 [a] ±4.40	0.0114 ±0.0018

[a-d] Means have different superscripts in the same column are significantly ($P \leq 0.05$) different.

***T1:** Fed basal diet (BD) with recommended levels of CP and ME (considered as control group), **T2:** Fed BD with -3% CP and -100 kcal ME. **T3:** Fed BD with -3% CP and recommended ME supplemented with four AAs (Lys, Met, Thr and Trp), **T4:** Fed BD with -3% CP and recommended ME supplemented with five AAs (Lys, Met, Thr, Trp and Val), **T5:** Fed BD with -3% CP -100 kcal ME supplemented with four AAs (Lys, Met, Thr and Trp), **T6:** Fed BD with -3% CP -100 kcal ME supplemented with five AAs (Lys, Met, Thr, Trp and Val).

That means the birds on the lower energy level of 2900 kcal/kg. will have to handle a greater volume for the lower energy feed per unit weight when organ involved in digestion, it may be that there was some enlargement of the gizzard in these birds to cope with increased volume of feed. **Ojediran *et al*., (2017)** show that the birds fed diet 4 (16.6% CP and 0.8% lysine) had a significantly ($p<0.05$) higher carcass weight. **Abudabos** *et al.,* **(2012)** delineate the effect of supplementation of low crude protein (CP) corn-soybean meal diets which contained low ME levels with lysine (Lys), methionine (Met) and threonine (Thr) above that recommended by the National Research Council (NRC, 1994) on carcass characteristics from 12 to 33 d of age. **Ardekani and Chamani, 2012)** mention that of total carcass weight of birds fed with low CP 16% with 0.73% l-threonine supplemented diets was increased compared to control diet 20% CP with 0.75% Thr. **Antonia *et al*. (1997)** observed that abdominal fat deposition increases in broilers received low crude protein diet supplemented with of L-Threonine to the basal diet. **Kidd *et al*. (1996**) observed that low crude protein treatments with amino acid fortified diets resulted in an increased of abdominal fat in cobb broilers of age 21 to 42 days. It has been suggested that abdominal fat pad deposition increases in broilers receiving low crude protein (16.8%) containing 0.78% Thr**.** Also, **Harn *et al.,* (2019)** who found that the broilers fed CP-1% or CP-2% feeding program had slaughter yields did not differ from the control feeding program. **Abdel-Maksoud *et al* .,*(*2010)** showed that chicks fed with low protein diets supplemented with amino acids had no negative impact on carcass characteristics. These results not agree with the findings of **Kamran *et al.,* (2008)** evaluated with low-CP and low-ME diets during the grower, finisher, and overall experimental period. They reported that carcass yield, abdominal fat, and relative live and heart weights were not affected by the treatments and with, **Rodriguez *et al*., (2016)** who reported that broilers fed four diets with different levels of energy had no significant differences on carcass yield percentage.

Biochemical indices in the blood plasma of broiler chickens:

Data presented in Table (5) showed that treatment applied had significant effect on total plasma globulin and A/G ratio only.T6 showed the higher average of plasma total protein (3.80 mg/dl) and globulin (1.91, mg/dl). While T1 and T3 showed the higher averages of plasma albumin (1.98 and 1.93 mg/dl, respectively). Similar results were observed in A/G ratio on (1.23 and 1.06 mg/dl) for T1 and T3,respectivaly.

Liver fraction and function :

1.* Fraction liver (*Plasma total protein, albumin, globulin and A/G ratio):

Total plasma proteins are a common parameter utilized to estimate the avian body condition. It is generally known that blood plasma proteins play key

Table (5): Effect of low dietary crude protein , metabolizable energy and ideal levels of amino acids on plasma total protein, albumin, globulin, and A/G ratio (Liver fraction) at the end of experiment.

Treatment groups.	Liver fraction			
	TP (mg/dl)	Ab (mg/dl)	Gb (mg/dl)	A/G ratio (mg/dl)
T1	3.60±0.057	1.98^{a}±0.0033	1.62^{b} ±0.54	1.23^{a}±0.040
T2	3.67±0.033	1.81^{b}±0.5811	1.86^{a} ±0.037	0.98^{b}±0.050
T3	3.76±0.066	1.93^{ab}±0.0317	1.83^{a} ±0.665	1.06^{b}±0.0432
T4	3.70±0.577	1.90^{ab}±0.0057	1.80^{a} ±0.069	1.05^{b}±0.0423
T5	3.76±0.100	1.91^{ab}±0.0437	1.85^{a} ±0.056	1.03^{b}±0.0276
T6	3.80±0.088	1.89^{ab}±0.0665	1.91^{a} ±0.049	0.99^{b}±0.0317

a-b Means have different superscripts in the same column are significantly($P<0.05$) different.
See abbreviations in Table 4.

roles in the maintenance of colloid osmotic pressure, especially under feed restricted conditions **(Yaman *et al.,* 2000; Filipoviæ *et al.,* 2007). Elmutaz *et al.,* (2014)** conducted to feeding the 16.2% CP diet increased serum triglyceride (P<0.05). **Swennen *et al.,* (2007)** and **Hada *et al.,* (2013)** reported that carbohydrate metabolism in broiler chicken was not affected by CP and ME levels in the diets. This may be due to the strict regulation of carbohydrate metabolism in the same birds to maintain the blood TP level **. Corzo *et al.,* (2005) and Hernandez *et al*., (2012)** fed broiler chickens with low-CP diets (3–4% in CP) and observed no change in plasma TP.

Corzo *et al*., (2009) and **Ahmadi *et al*., (2015)** commented that TP will only be affected when diets ingested by the animals are deficient in AA. Thus, it appears that meeting the AA requirement could be more important than the CP. Changes in its levels depend on many external and internal factors and result from the physiological role of blood proteins. The increasing concentration of total proteins and albumin between the group is probably a direct consequence of high demand for amino acids which are utilized for very intensive somatic growth (**Filipoviæ *et al.,* 2007). Abudabos and Aljumaah., (2012)** observed similar results of high plasma protein level in low crude protein diet treatment than control group. **Corzo *et al.,* (2005) and Hernandez *et al.,* (2012)** fed broiler chickens with low-CP diets (3–4% in CP) and observed no change in plasma TP. Thus, it appears that meeting the AA requirement could be more important than the CP.

The results obtained agree with those of **Awad *et al*., (2014)** who found that the plasma total protein of the 16.2 % crude protein fed group was found to be significantly lower than that groups having 22.2 % crude protein.

2. Liver function (Plasma alanine aminotransferase (ALT) and aspartate aminotransferase (AST):

Data presented in Table 6 revealed highly significant effect of treatments applied on plasma ALT and AST. Birds of T2 and T5 showed significantly($P \leq 0.005$) the lowest average of plasma ALT (27.3 and 30.0 u/l, respectively. While T3 and T2 showed the lowest average of plasma AST (144.0 and 159.0 u/l, respectively) when compared with different treatments applied. .

The blood is usually a reflection of the breakdown of cells or the occurrence of a disease condition. AST is one of the most important enzymes in the aminotransferase group which catalyses alpha-keto acid to amino acids by transferring amine units. Evaluation of aspartate aminotransferase activity is a basic method for the diagnosis and assessment of liver and / or muscle damage. Generally, increasing aspartate aminotransferase has a high correlation with the amount and severity of cell damage **(Nobakht and Hosseini., 2016). Abdel-Hafeez *et al.,* (2016)** showed that the blood parameters had no significant

Table (6): Effect of dietary treatment on plasma alanine aminotransferase (ALT) and aspartate aminotransferase (AST) at the end of experiment.

a-c Means have different superscripts in the same column are

Treatment groups.	Liver function	
	ALT	AST
T1	34.0 ^{b} ±2.082	179.3 ^{b} ±5.812
T2	27.3 ^{c} ±1.764	159.0 ^{bc} ±3.786
T3	42.3 ^{a} ±1.855	144.0 ^{c}±13.279
T4	36.0 ^{b} ±2.082	203.7 ^{a} ±4.484
T5	30.0 ^{bc} ±2.08	171.0 ^{b} ± 1.528
T6	33.7 ^{b} ±1.452	165.7 ^{b} ±3.756

significantly(P<0.05) different.

See abbreviations in Table 4.

variations among the groups, except for total protein, ALT and AST, which had an increased response to decreased dietary energy. This result has agreed with

Kidney function (Plasma creatinine, urea and glucose):

Data presented in Table 7 showed insignificant effect of plasma creatinine, urea and glucose of treatments applied had insignificant effect on plasma createnine and urea. T3,T4 and T6 showed the same lowest average of plasma creatinine (0.23mg/dl).While T2 and T6 showed the lowest averages of plasma urea (11.0 and 12.0 mg/dl, respectively) compared with different treatments applied. It is interesting to note that birds received low energy and protein plus amino acids diet had lower creatinine level than those of controls group. Plasma level of creatinine is considered a myopathy (muscle breakdown) marker when there is cell membrane damage and permeability changes **(Sandercock *et al.*, 2001).** It is possible that the variations in dietary CP and ME among the dietary groups caused the higher creatinine level by increasing the muscle breakdown at the expense of muscle synthesis. The phenomenon could be attributed to the lower calorie/protein in the mentioned diets **(Gaine *et al.*, 2006).**On the other hand, The high protein concentration typical of commercial diets used in the starter phase of broiler rearing results in a higher urea concentration content **(Szabo *et al.*, 2005).** On the other hand, no significant effect in urea concentration was found by **Rajman *et al.*, (2006)** in growing meat-type chickens and by **Schmidt *et al.*, (2007)** in pheasants, additionally confirming the great variability in uric acid content in birds.

In addition, showed insignificant effect of plasma glucose level due to

Table (7): Effect of low dietary crude protein , metabolizable energy and ideal levels of amino acids **on** Creatinine, Urea and glucose at the end of experiment.

Treatment groups	***Kidney function***		
	Creatinine (mg/dl)	**Urea (mg/dl)**	**Glucose (mg/dl)**
T1	0.33±0.088	12.3 ^{ab} ±0.333	177.67±18.27
T2	0.30±0.100	11.0 ^{b} ±0.577	164.67±6.385
T3	0.23±0.033	14.0 ^{a} ±0.1527	171.67±16.74
T4	0.23±0.0333	13.67 ^{ab} ± 0.333	177.67±3.382
T5	0.27±0.0333	13.0 ^{ab} ±0.5772	146.00±18.00
T6	0.23±0.0333	12.0 ^{ab} ±1.000	175.00±12.34

$^{a\text{-}b}$ Means have different superscripts in the same column are significantly(P<0.05) different.

See abbreviations in Table 4.

treatments applied. Plasma glucose level in T5 and T2 showed the lowest average of plasma glucose level (146.0 and 164.7 mg/dl, respectively). However, T1 and T4 showed the higher average of plasma glucoses compared with different treatment applied.

Swennen *et al.,* (2007) and Hada *et al.,* (2013) reported that carbohydrate metabolism in broiler chicken was not affected by CP and ME levels in the diets. This may be due to the strict regulation of carbohydrate metabolism in the same birds to maintain the blood GLU level**. Corzo *et al.,* (2005) and Hernandez *et al.,* (2012)** fed broiler chickens with low-CP diets (3–4% in CP) and observed no change in plasma TP. Thus, it appears that meeting the AA requirement could be more important than the CP.

Plasma Triglycerides (TG) and very low density lipoprotein (VLDL):

Treatments applied showed highly significant effect on plasma TG and VLDL in Table 8. Birds of T4 and T1, respectively showed the higher average of TG and VLDL. However, T3 has the lower averages of plasma TG (16.33 and 3.26 mg/dl, respectively. **Whitehead and Griffin (1984)** indicated that plasma VLDL is a useful parameter to infer the degree of fatness in chickens. In the present study, chicks fed the Low CP + Met + Lys diets had higher plasma triglyceride and VLDL than those fed with conventional diet group at both 21 and 42 days of age. Likewise, **Nukreaw *et al.,* (2011)** found that adding Met to a low protein diet linearly increased the triglyceride and VLDL concentrations in serum. The increase in serum VLDL by Met supplementation may be caused by the

Table (8): Effect of low dietary crude protein , metabolizable energy and ideal levels of amino acids on plasma triglycerides (TG) and very low density lipoprotein (VLDL) at the end of experiment.

Treatment groups	TG (mg/dl)	VLDL (mg/dl)
T1	24.00^{a}±1.527	4.80^{a}±0.305
T2	17.00^{c} ±1.527	3.40^{c}±0.305
T3	16.33^{c} ±1.452	3.26^{c}±0.290
T4	25. 00^{a} ±1.154	5.00^{a}±0.267
T5	17.67^{bc} ±1.452	3.53^{bc}±0.290
T6	21.67^{ab}±1.452	4.33^{ab}±0.291

a-c Means have different superscripts in the same column are significantly(P<0.05) different.

See abbreviations in Table 4.

stimulation of triglyceride-rich lipoprotein secretion from the liver or by depression of the activity of lipoprotein lipase **(Wegner *et al*., 1978).** This study is agreement with **Dehghani and Jahanian (2016)** reported that irrespective of energy density, birds grown on low-CP diets had higher TG. It appears that the TG level is associated with calorie/protein and the excessive energy intake above the requirement level resulted in higher TG and therefore higher abdominal fat deposition **(Swennen *et al.,* 2007). Griffin *et al.,* (2008)** suggest that measurements of plasma triglyceride concentration could be used as an indirect means of selecting for decreased body fat content in broiler breeding programs. On the other hand, **Krasnodêbsk and Koncicki., (2000)** reported that should be pointed out that both cholesterol and triglyceride serum levels are genetically dependent. This may be one of the reasons for their great variability revealed by different researchers in experiments on growing chickens.

***Conclusively,* i**t can be recommended by decreasing CP 3 % and ME 100 kcal/kg diet without affecting carcass characteristics and metabolic response with supplemental (Lys, Met, Thr, Trp, and Val) to obtain the best performance of broiler diets.

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تأثير خفض البروتين الخام والطاقة الممثلة في العليقة والمستويات المثلي من الأحماض الأمينية علي خصائص الذبيحة والإستجابة الأيضية لدجاج التسمين.

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اجريت هذه الدراسة لدراسة الاستجابة لانخفاض البروتين الخام والطاقة الغذائية مع إضافة مستوى مثالي من الأحماض الأمينية على خصائص الذبيحة و بعض الاستجابة الايضيه لكتاكيت التسمين. في عمر يوم واحد ، تم تخصيص ٢٧٠ كتكوتًا عشوائياً لست مجموعات غذائية ؛ المعاملة الاولي: كونترول إيجابي مع نظام غذائي أساسي بمستوى البروتين والطاقة الموصى به ، المعاملة الثانية: كونترول سلبي التغذية بنظام غذائي أساسي مع (-٣ ٪ بروتين خام و -١٠٠ ك كالوري من المتطلبات) ؛ تم تغذية المعاملة الثالثة والرابعة بنظام غذائي اساسي (-٣ % بروتين خام) ولكن تم استكمالهما بشكل متزايد بأربعة وخمسة احماض امينية اساسية (الليسين والمثيونين والثريونين والتربتوفان والفالين على التوالي) ؛ تم تغذية المعاملة الخامسة والسادسة بـ الكونترول السلبي ولكن تم استكمالهما بشكل متزايد بأربعة وخمسة احماض امينية اساسية (الليسين والمثيونين والثريونين والتربتوفان والفالين على التوالي). من ١ إلى ٣٥ يومًا ، لتغطية المتطلبات الغذائية لكل الاحماض الامينية خلال فترات البادي والنامي والناهي. كان للمعاملات المستخدمة تأثير معنوي عالي على الوزن المطلق للذبيحة والكبد ودهون البطن ونسبة الذبيحة ووزن القلب والقوانص على التوالي. اظهرت طيور المعامله ١ ،٦ متوسط أعلى للوزن المطلق للذبيحة (١٥٦٥.٠ ، ١٤٦٥.٠ جم) والوزن النسبي للدهون البطنية (١٠٩٠.٠ ، ٠.٠١١ ٪ ، على التوالي) مقارنة مع المعاملات المختلفة المطبقة. أظهرت الطيور المعاملة ٤ ،٢ أقل وزن مطلق ونسبي لدهن البطن (٨.٣٣،١١.٦٧ جم - ٠.٠٠٥٧،٠.٠٠٦٥٪ على التوالي). كان للمعاملات المستخدمة تأثير معنوي على بلازما الجلوبيولين ونسبة الالبيومين الي الجلوبيولين و كذلك انزيمات الكبد طوال الفترات. اظهرت طيورالمعاملة السادسة أعلى متوسط لـلبروتين الكلي (٣.٨٠) والجلوبيولين (١.٩١ مجم / ديسيلتر) وأدنى متوسط للكرياتينين واليوريا. ومع ذلك ، أظهرت المعاملة ٤ ،١ اعلي متوسط من الدهون الثلاثية (٢٥.٠٠ ، ٢٤.٠٠ مجم / ديسيلتر) والبروتين الدهني منخفض الكثافة جدا(٥.٠٠ ، ٤.٨٠ مجم / ديسيلتر على التوالي).
التوصية:يمكن التوصية بخفض ٣ % بروتين خام و ١٠٠ ك كالوري/كجم عليقة من النظام الغذائي دون التأثير على خصائص الذبيحة والاستجابة الأيضية مع مكملات (الليسين والمثيونين والثريونين والتربتوفان والفالين) للحصول على أفضل أداء للسلالة المغذاه علي العلائق الموصي به