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Response of Broiler Chicks to Low-Protein-L-Valine Supplemented Diets Formulated Based on Digestible Amino Acids

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ABSTRACT

The present studywas designed to evaluate the influence of supplementing different levels of L-Valine (L-Val) to low protein diet on chicks' performance, carcass characteristics , digestibility of nutrients andeconomical efficiency. A total number of 640 unsexed day old Arbor Acres meat – type chickswere assigned randomly into 8 equal treatments containing 80 chicks each (10 birds/ replicate). The first group (control) was fed strain recommendation of CP being 23%, 21% and 19% with 0.96, 0.88 and 0.79% digestible valine during starter, grower and finisher periods, respectively (T1). The 2^{nd} group was feddiets with a 3% CPless thanthe control, being 20%, 18% and 16% and contained 0.89, 0.79 and 0.69% digestible valine level during the same growth phasesrespectively, as control (T2). Other six groups were fed low–CP diet (LPD) supplemented with 250mg, 500mg, 750mg, 1000 mg, 1250 mg and 1500 mgL-Val/kg diet, respectively. The study lasted for 38 days. The results were as follows:1- The best BWG and FCR during overall growth period was achieved by chicks fed the LPD supplemented with 500 mg Val/kg diet, and control group (T1) without significant differences between them.2- Valine digestibility was ranged between 91.17 to 97.03%.3-Control group achieved significantly the lowest abdominal fat percentage as compared to the other groups fed LPD either with or without valine supplementation.4- Chicks fed the LPD plus 500 mg Val/kg diet attained the highest means of economic efficiency and its relative value by 103.2% and 114.2% as compared to those fed the recommended protein diet and LPD, respectively. In conclusion, the best level of added Val is 500 mg/kg diet for broilers fed LPDsupplemented with sufficient amount of Methionine, Lysine, Threonine which coincided with the best Val/Lys ratio during starter, grower and finisher periods. Also, it achieved an improvement in economic efficiency and growth performance of broilers.

INTRODUCTION

Nowadays, the poultry industry has to deal with ongoing increases in the price of various feed in gredients. Using of low crude protein (CP) diets with amino acids supplementation in broiler chicks formulas received great interest in the recent years as an alternative way for reducing feeding costs, pollution and to improve protein utilization under different environmental conditions (Attia *et al.,* 2001).When the cost of protein-rich feed ingredients rises, the reduction of dietary protein by using commercially available amino acids becomes an effective formulation strategy that can reduce diet costs and maintain broiler performance. Studies concerned with low crude protein diets without supplemental amino acids showed reduction of growth performance compared to chicks that fed optimum amino acids in diets (Berres *et al.,* 2007). However, when AA level is considered in the formulation of diets, a reasonable reduction in CP may create acceptable growth performance (Kerr and Kidd, 1999b).

It is known that Val is the fourth limiting AA in vegetable broiler rations based on wheat or corn (Fernandez *et al.,*1994; Han *et al.,* 1992,Corzo*et al.,* 2007 and Corrent and Bartelt 2011). At the present time, synthetic L-Valis available to be incorporated into diets. The order of Val limitation is dependent on the ingredients used in diet formulation (Kidd *et al.,* 2000). However , in corn, soybean meal or poultry by-product meal diets ,Corzo *et al.,* (2009) found that Val was not the fourth limiting amino acid but isoleucine becomes co-limiting when the feed conversion response is observed .Since supplementation of Val did not showed any evidence to provide its commercial form to diets (Leclercq, 1998).

Valine requirements have been determined for meat – type strains of chickens by Corzo *et al.* (2004), who estimated a total Val requirement of 7.3 g/kg (6.7 g digestible Val/kg) for Ross×Ross 308 broiler males from 6 to 7 weeks of age. In another study withthe same strain, the requirements from Val was 8.5 g /kg (equal to 7.8 g true digestible Val/kg) for the finisher feeding stage (Corzo *et al.,* 2008). With high-yield broilers (Ross×Ross 708) the requirements were 7.03 g digestible Val/kg for body weight gain and 6.65g for breast meat during the growth period from 3 – 6 weeks of age(Corzo *et al.,* 2007).Also ,Thornton *et al.* (2006)found that Ross 508 male broilers given 7.3 g Val/kg of diet displayed better body weight gain and feed efficiency compared with birds receiving 6.4 g Val/kg of diet. Therefore, the present study was conducted to examine the response of broiler chicks to L-Val addition to LPD on performance, nutrient digestibility, carcass characteristics and economic efficiency of growth.

MATERIALS AND METHODS

The experimental work was done at El-Fayoum Poultry Farm, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt.

Birds and Experimental Diets:

A total number of 640, day-old unsexed Arbor Acres broiler chicks were divided equally into eight treatment groups of 80 chicks in 8 - replications , 1o chicks each . The eight groups were as follows: The first (control) group, received the strain recommended dietary levels of CP (23%, 21% and 19% during the starter, grower and finisher periods, respectively) , while the 2^{nd} group was fed low crude protein diet (LPD), less 3% than the previous recommendation levels ; being 20%, 18% and 16% during the same growth periods ,and the 3^{rd} , 4^{th} , 5^{th} , 6^{th} , 7^{th} and 8^{th} groups received LPD supplemented with 250, 500, 750, 1000, 1250 and 1500mg L-Val/kg diet, respectively. The experimental period lasted for 38 days of age. Chicks were fed corn-soybean based diets during the starter (1-10 days), grower (11-24 days) and finisher (25-38 days old) phases of growth. All diets were formulated to meet the nutrient requirements of Arbor Acres broilers (Table 1). Feed and water were provided *ad libitum*. All chicks were housed in battery cages and kept under the same managerial, hygienic and environmental conditions . They vaccinated against common viral diseases. Live body weight (LBW) and feed intake (FI) were recorded individually at the start and end of each growth period, then weight gain (BWG) and feed conversion ratio (FCR) were calculated.

Table 1. Composition of the basal diets used in this study

Ingredients	Starter diets (0-10 days)		Grower diets (11-24 days)		Finisher diets (25-38 days)	
	Control diet	Low protein diet	Control diet	Low protein diet	Control diet	Low protein diet
Yellow corn	53.07	62.77	58.86	67.50	63.83	72.57
Soybean meal (44% CP)	33.02	25.39	25.94	20.20	21.85	16.01
Corn glutein meal (60% CP)	6.32	5.23	7.55	5.19	6.70	4.35
Vegetable oil	3.00	1.50	3.50	2.50	3.70	2.70
Di calcium phosphate	1.84	1.91	1.63	1.69	1.51	1.57
Limestone	1.27	1.29	1.17	1.19	1.14	1.15
Common salt	0.40	0.40	0.40	0.40	0.40	0.40
Sodium bicarbonate	0.10	0.10	0.10	0.10	0.10	0.10
Vit. & min. mix.*	0.30	0.30	0.30	0.30	0.30	0.30
DL-Methionine	0.25	0.33	0.18	0.27	0.15	0.24
L- Lysin.HCl	0.37	0.60	0.34	0.52	0.30	0.48
L- Threonine	0.06	0.18	0.03	0.14	0.02	0.13
Total	100	100	100	100	100	100
Price (LE)/ton	3459	3336	3416	3285	3323	3192
Calculated analysis**						
CP, %	23.1	20.1	21.07	18.04	19.06	16.01
ME (kcal/kg)	3020	3021	3140	3141	3198	3200
CF, %	3.74	3.40	3.39	3.13	3.19	2.92
EE, %	5.65	4.38	6.29	5.48	6.59	5.79
Calcium, %	1.00	1.00	0.90	0.90	0.85	0.85
Aval. Ph, % (Non phytate P,%)	0.50	0.50	0.45	0.45	0.42	0.42
Digestible Met.+Cys.	0.94	0.94	0.84	0.84	0.76	0.76
Digestible Lysine, %	1.25	1.25	1.12	1.12	0.99	0.99
Digestible Threonine, %	0.83	0.83	0.73	0.73	0.65	0.65
Digestible Valine, %	0.96	0.89	0.88	0.79	0.79	0.69

***Each 3 kg contains: Vit A12 000 000 IU,Vit D_3 2 000 000IU, Vit E 10g, Vit K_3 2g, Vit B_1 1g,Vit B_2 5g, Vit B_6 1.5g, Vit B_{12} 10mg , Nicotinic acid 30g, Pantothenic acid 10g, Folic acid 1g, Biotin 50mg, Choline 250g, Iron 30g, Copper 10g, Zinc 50g, Manganese 60g, Iodine 1g, Selenium 0.1g, Cobalt 0.1g and carrier ($CaCO_3$) up to 3 kg.,**

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

Digestibility Trial Technique:

At the end of finisher period, 24 chicks (3 per treatment) were used to determine the digestibility coefficients of nutrients and percentages of digestible amino acids. The experimental diets and water were offered ad-libitum, while excreta were collected and sprayed with 1% boric acid to prevent any loss in ammonia, then dried at 60 ^{o}C for 24 hrs. The diets and dried excreta were analyzed (AOAC, 1990) for dry matter (DM), crude protein (CP), Ether Extract (EE), Crude fiber (CF), organic matter (OM) and nitrogen free extract (NFE) at the Central Laboratory of Foods and Feeds, Agricultural Research Center, Ministry of Agriculture, Egypt. Amino acid (AA) digestibility was expressed as the difference between AA intake and AA excreted in excreta as a proportion of amount consumed (McNab, 1994).

Amino acids digestibility = [((AA consumed –AA in excreta) /AA consumed) ×100]

Slaughter Test and Meat Quality:

At 38 days of age, 6 birds from each treatment were chosen to evaluate carcass characteristics. Studied traits included carcass yield, abdominal fat and giblets as a percentage of live body weight. Hot carcasses were cut to evaluate the boned breast yield and thigh + drumstick yield.

Economic Efficiency:

The economic efficiency of growth (EEG) for the whole experimental period was calculated as follows: EEG=100× [(sale price per total gain – total feed cost)/ total feed cost]. The relative economic efficiency (REE) for meat production was estimated as the amount of feed consumed/bird during the entire experimental period multiplied by the price of Kg of diet to calculate the total feed cost based on local current prices at the experimental time

Statistical Analysis:

Data were subjected to SAS (2001) ANOVA, using the following fixed model:

$$Y_i = \mu + T_i + eijk$$

Where: Y_i = The observation; μ = Overall mean; T_i = Effect of treatments (i = 1, 2, 3,…., 8); e= Random error. All percentage values were transformed to the corresponding arcsine values (Ewens and Grant, 2005). The differences between means were tested using Duncan's new multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Calculated digestible Val: Lys ratios were listed in Table 2 assuming that the digestibility of valine is about 91% as reported by Corzo *et al.,* (2008).Total digestible Val was calculated as added digestible Val plus digestible Val present in feed ingredients used at each growth period, then Val/Lys ratios were calculated.

Table 2. Calculated Val to Lys ratios in experimental diets of broilers fed during the three growth periods

Treatments	Supplemental Digestible Val. %	Val/Lys ratio (%) Starter period	Grower period	Finisher period
T1 (Control)	------	76.8	78.6	79.8
T2 (LPD)	------	71.2	70.5	69.7
T3 (Val 250mg/kg)	0.023	73.0	72.6	72.0
T4 (Val 500mg/kg)	0.046	74.9	74.6	74.3
T5 (Val 750mg/kg)	0.068	76.6	76.6	76.6
T6(Val 1000mg/kg)	0.091	78.5	78.76	78.9
T7(Val 1250 mg/kg)	0.11	80.0	80.4	80.8
T8(Val 1500mg/kg)	0.14	82.4	83.0	83.8

LPD= low protein diet

Growth performance:

Effect of different treatments on growth performance is presented in Tables 3 and 4.

During starter period (1-10 d) chicks fed LPD supplemented with 500 mg Val/kg diet with 74.9% Val/Lys ratio (0.936% digestible Val) had significantly higher LBW and BWG than those fed LPD (T2).However , there were insignificant differences in FI and FCR between all treatments as shown in Table 3. In close agreement with these results are those reported by Corzo *et al.* (2008), who found that the requirements of digestible Val for Ross broiler chicks during 1-14 day of age is 0.91%. Also, Good game *et al.* (2011) found that during 1-21 days of age, Cobb – 500 chicks need 0.9 % digestible Val. The estimated value of Val : Lys ratio, reported herein, is slightly lower than that reported by Tavernari *et al.* (2013), who concluded that the ideal digestible Val/Lys ratio for Cobb × Cobb 500 broilers is 77% in the starter period. This may be due to the extended evaluation period in the previous research and the growth rate and nutrient needs of the broiler strain used. It is possible that the enhanced growth performance by supplemental valine is related to its role in the synthesis of polyamines, which had beneficial effects on cell division, protein synthesis, and tissue growth (Peggand McCann 1982) and intestinal development (Löser*et al.* 1999).

Table 3. Effect of adding various levels of L-Valineto low-CP diets on growth performance of broiler chicks during starter and grower periods

Treatments	Starter period (1-10 days) LBW (g)	BWG (g)	FI (g)	FCR	Grower period (11-24 days) LBW (g)	BWG (g)	FI (g)	FCR
T1 (Control)	219^{ab}	174^{ab}	261	1.50	937^{a}	718^{a}	1221^{abc}	1.70^{a}
T2 (LPD)	198^{cd}	153^{cd}	235	1.54	813^{d}	615^{c}	1137^{d}	1.85^{ab}
T3 (Val 250mg/kg)	210^{abc}	165^{abc}	242	1.47	922^{ab}	712^{ab}	1274^{a}	1.79^{ab}
T4 (Val 500mg/kg)	220^{a}	175^{a}	236	1.35	913^{abc}	693^{ab}	1183^{bcd}	1.71^{a}
T5 (Val 750mg/kg)	205^{bcd}	159^{cd}	243	1.53	872^{bcd}	667^{bc}	1260^{ab}	1.89^{b}
T6(Val 1000mg/kg)	211^{abc}	166^{bcd}	242	1.46	840^{d}	629^{c}	1165^{cd}	1.85^{ab}
T7(Val 1250 mg/kg)	206^{abcd}	162^{cd}	244	1.51	855^{cd}	649^{bc}	1212^{abcd}	1.87^{ab}
T8(Val 1500mg/kg)	194^{d}	149^{c}	231	1.55	857^{cd}	663^{bc}	1255^{abc}	1.89^{ab}
SEM	2.48	9.37	2.560	.024	9.05	8.366	11.69	0.222
P value	0.025	0.010	NS	NS	0.001	0.002	0.004	0.02

Initial weight = 45 g ±1, a-d: Means in each column, with common superscripts are not significantly different (P≤0.05). LPD= low protein diet, NS= Not significant, SEM= Standard error of the means.

Table 4. Effect of adding various levels of L-Valineto low-CP diets on growth performance of broiler chicks during finisher and overall periods

Treatments	Finisher period (25-38 days) LBW (g)	BWG (g)	FI (g)	FCR	Overall period (1-38 days) LBW (g)	BWG (g)	FI (g)	FCR
T1 (Control)	1868^{a}	931	1573^{ab}	1.69^{a}	1868^{a}	1823^{a}	3055	1.68^{a}
T2 (LPD)	1713^{abc}	900	1684^{a}	1.87^{b}	1713^{abc}	1668^{abc}	3056	1.83^{b}
T3 (Val 250mg/kg)	1733^{abc}	811	1440^{b}	1.78^{ab}	1733^{abc}	1688^{abc}	2956	1.75^{ab}
T4 (Val 500mg/kg)	1827^{ab}	914	1517^{ab}	1.66^{a}	1827^{ab}	1782^{ab}	2936	1.65^{a}
T5 (Val 750mg/kg)	1608^{c}	736	1387^{b}	1.88^{b}	1608^{c}	1562^{c}	2890	1.85^{b}
T6(Val 1000mg/kg)	1722^{abc}	882	1654^{a}	1.88^{b}	1722^{abc}	1677^{abc}	3061	1.83^{b}
T7(Val 1250 mg/kg)	1664^{bc}	809	1519^{ab}	1.88^{b}	1664^{bc}	1620^{bc}	2975	1.84^{b}
T8(Val 1500mg/kg)	1672^{bc}	815	1551^{ab}	1.90^{b}	1672^{bc}	1627^{bc}	3037	1.87^{b}
SEM	20.84	18.85	22.87	0.096	20.84	20.84	22.59	0.02
P value	0.022	NS	0.009	0.03	0.022	0.022	NS	0.001

a-c: Means in each column, with common superscripts are not significantly different (P≤0.05). LPD= low protein diet, NS= Not significant,SEM= Standard error of the means.

During the grower phase, chicks fed the control diet (T1) recorded significantly higher LBW and BWG compared with those fed the LPD, but the best FCR value was achieved by chicks fed either the control diet or LPD supplemented with 500mg Val/kg diet (T4) with a 74.6% Val/Lys ratio. The improvement in FCR for T4 group was 7.6% comparing with LPD group (T2). The estimated digestible val for the grower phase was 0.836% whichwas less than that reported by Corzo *et al.* (2008),who noted that 0.86% digestible Val is optimal level to maximize Ross broiler chicks growth performance during the period of 14-28 day.

At 38 days of age , chicks of both control group and those fed the LPD plus 500 mg Val/kg diet displayed better LBW and FCR than other treatments, without significant differences between them(Table 4) . A Val: Lys ratio of 74.3% for chicks fed LPD plus 500 mg Val/kg diet in the finisher phase was lower than the recommended level suggested by Mack *et al.* (1999), who found better performance of broilers fed on diets with 81% valine: lysine ratio from 20 to 40 days of age . Furthermore, Corzo *et al.* (2007) recommended valine: lysine ratio of 78% (0.74% digestible Val in diet) for broilers from 21 to 42 days of age . Similarly ,Tavernari *et al.* (2013) found that the best ratiois 76% for Cobb × Cobb 500 broiler chicksduring the finishing period (30 to 43 days). Additionally ,Duarte *et al.* (2014) reported digestiblev aline : lysine ratios of 76.00%, 79.00% and 84.12%, for best feed intake, weight gain and feed conversion ratio, respectively during the period from 22 to 42 days of age. Our results are also in line with the findings of Corzo *et al.* (2008) who declared that the valine: lysine ratio for Ross chicks from 28 to 42 days was 74% or 0.78% . However, the best level of digestible Val (0.736%), which was recorded for chicks that fed 500 mg Val/kg diet, was slightly higher than digestible Val requirement found by Mendoca and Jensen (1989), who recommended a dietary digestible Val level of 0.72% for a feeding stage between 21 and 42 d of age

During the whole experimental period, chicks fed the LPD plus 500 mg Val/kg diet exhibited the best BWG and FCR which was insignificantly different from that of birds fed the control diet. The percent improvement in FCR of birds fed the LPD plus 500 mg Val/kg diet was 9.8% comparing to LPD. Along the same line, Parr and Summers(1991) reported that chicks fed low- CP diets, ranging from 21 to 16.5% CP and supplemented with essential amino acids had the same BWG and FCR to those fed a 23% CP diets. Our finding agree also with that of Han *et al.* (1992), who observed that low-protein diets fortified with Met, Lys, Thr, Val, Arg, and amino nitrogen from Glu resulted in bird performance equivalent to that of a high-protein diet. Also Ferguson *et al.* (1998) suggested that if essential amino acids requirements are met, dietary CP could be decreased by nearly 2% . Our results show that after certain level of L-Val supplementation (500 mg/kg diet) the performance of chicks was decreased. In this connection, many amino acids, when fed in excess to growing chickens, cause toxic effects such as depressions in growth and decreases in feed intake (Carew *et al.,* 1998). Also, Corzo *et al.* (2011) concluded that L-Val supplementation level under0.52 kg/ton showed can support good production perforemance. Also, Widyaratne and Drew (2011) suggested that low-protein diets can support broilers growth performance equal to high-protein diets when highly digestible ingredients are used. The growth improvement by valine supplementation may be due not only to its role as a building block of proteins and polypeptides, but it may also regulate key metabolic pathways that are necessary for maintenance, growth and immunity. Valine has been reported to be one of the functional AA (Wu, 2014), that may maximize the feed efficiency and protein utilization , reduce abdominal fat , and enhance the health of animals.

Digestibility of nutrients:

Effect of supplementing L-Val to low-CP diets on nutrient and amino acids digestibility are listed in Tables 5 and 6.

It is noticeable that the chicks fed LPD supplemented with the highest L-Val inclusion level (1500 mg Val/kg diet) achieved significantly the best OM% digestibility as compared to the other treatments (Table 5). With the exception of birds fed the LPD plus either 500 mg or 1250 mg Val/kg diet, all groups of chicks fed various levels of L-Val showed an improvement in EE digestibility values than the group fed the LPD without supplementation (T2). However, dietary treatments had no significant effect on the digestibility of CP, CF and NFE.

Table 5. Effect of adding various levels of L-Valine to low-CP diets on nutrient digestibility of broiler chicks

Treatments	OM%	CP%	EE%	CF%	NFE%
T1 (Control)	77.80 ^{b}	92.63	87.29 ^{cd}	24.39	81.07
T2 (LPD)	78.61 ^{b}	92.70	86.48 ^{d}	25.60	79.37
T3 (Val 250mg/kg)	78.09 ^{b}	91.80	89.54 ^{bc}	24.87	82.43
T4 (Val 500mg/kg)	78.12 ^{b}	93.00	87.08 ^{cd}	25.67	78.33
T5 (Val 750mg/kg)	77.79 ^{b}	91.67	89.68 ^{bc}	25.17	82.00
T6(Val 1000mg/kg)	77.91 ^{b}	91.33	92.54 ^{a}	26.37	78.00
T7(Val 1250 mg/kg)	78.76 ^{b}	91.50	89.14 ^{bcd}	25.20	78.67
T8(Val 1500mg/kg)	81.15 ^{a}	91.87	90.52 ^{ab}	26.05	82.20
SEM	0.68	3.41	0.84	5.13	6.17
P value	0.04	NS	0.002	NS	NS

LPD= low protein diet, NS= Not significant

a-d: Means in each column, with same superscripts are not significantly different (P<0.05), SEM= Standard error of the means.

Table 6. Effect of adding various levels of L-Valineto low-CP diets on amino acid digestibility of broiler chicks

Treatments	Valine (%)	Isoleucine (%)	Leucine (%)	Arganine (%)	Methionine(%)	Cystine(%)	Lysine(%)	Threonine(%)
T1 (Control)	95.00 ^{b}	87.17 ^{a}	91.71	92.25 ^{a}	94.00	90.00	88.93	87.73
T2 (LPD)	91.17 ^{d}	82.69 ^{c}	88.38	86.62 ^{c}	88.93	84.00	85.03	84.76
T3 (Val 250mg/kg)	93.10 ^{c}	84.30 ^{bc}	89.27	87.32 ^{bc}	90.00	86.17	87.97	84.92
T4 (Val 500mg/kg)	93.67 ^{bc}	85.32 ^{ab}	91.23	89.93 ^{ab}	92.10	85.17	85.84	88.53
T5 (Val 750mg/kg)	94.00 ^{bc}	85.31 ^{ab}	89.41	89.72 ^{abc}	92.83	87.17	88.42	85.55
T6(Val 1000mg/kg)	94.30 ^{bc}	85.17 ^{ab}	90.39	89.47 ^{abc}	92.20	88.00	88.66	85.11
T7(Val 1250 mg/kg)	96.60 ^{a}	85.17 ^{ab}	89.77	89.23 ^{abc}	93.30	87.53	87.99	86.85
T8(Val 1500mg/kg)	97.03 ^{a}	83.76 ^{bc}	90.16.	88.89 ^{bc}	93.60	88.67	86.56	86.70
SEM	0.51	0.68	3.30	0.97	2.42	3.01	3.76	2.31
P value	0.0001	0.01	NS	0.03	NS	NS	NS	NS

a-d: Means in each column, with common superscripts are not significantly different (P≤0.05). LPD= low protein diet, NS= Not significant, SEM= Standard error of the means.

Results listed in Table 6 show that there were significant differences between groups in valine digestibility. Chicks fed the LPD supplemented with 1500 mg Val/kg diet recorded the highest Valdigestibility coefficient (97.03%) followed by those fed the LPD plus 1250 mg Val/kg diet (96.60%) but birds fed LPD (T2) recorded the lowest value (91.17%). It is clear that the digestibility of valine was increased gradually by increasing digestible valine in the diet.

It is well known that the digestibility of isoleucine increased till a certain level of Val in the diet (1250 mg Val/kg diet) then it decreased. Since valine and isoleucine are branched amino acids , an excess of one of them can negatively affect the needs of the other (Smith and Austic, 1978). Feeding the LPD negatively affected arginine digestibility compared with the control group. But added dietary Val led to a significant improvement in arginine digestibility up to the level of 500 mg/kg diet compared with those fed the LPD. On the other hand, dietary Valsupplementation had no significant effect on the digestibility of other amino acids .

Table 6. continue: Effect of various levels of L-Valine on amino acid digestibility

Treatments	His. (%)	Asp. (%)	Ser. (%)	Glu. (%)	Pro. (%)	Gly. (%)	Tyr. (%)	Alan. (%)	Phen. (%)
T1 (Control)	90.91	93.05	88.93	93.00	91.08	88.00	90.44	89.38	89.46
T2 (LPD)	87.15	83.23	85.06	89.08	86.54	81.30	84.30	83.28	85.92
T3 (Val 250mg/kg)	88.32	85.49	88.01	89.38	88.33	81.00	86.34	85.90	86.31
T4 (Val 500mg/kg)	90.29	88.17	88.51	91.87	90.01	85.13	85.13	86.50	86.12
T5 (Val 750mg/kg)	89.37	86.49	86.48	90.75	91.82	78.73	85.13	85.83	86.83
T6(Val 1000mg/kg)	89.56	86.81	88.16	90.81	91.80	81.92	86.09	86.47	87.95
T7(Val 1250 mg/kg)	88.54	86.85	86.87	89.78	91.52	82.82	89.28	84.99	87.55
T8(Val 1500mg/kg)	89.36	87.00	89.24	91.40	91.81	85.44	87.44	85.52	89.41
SEM	3.51	2.64	2.60	2.02	2.58	6.49	3.40	2.68	2.86
P value	NS	NS	NS	NS	NS	NS	NS	NS	NS

LPD= low protein diet, NS= Not significant, His.=Histidine, Asp.= Aspartic,Ser.=Serine,Glu.=Glutamic,Pro.= Proline,Gly.= Glycine,Try.=Tyrosine Alan.=Alanine, Phen.=Phenylalanine, SEM= Standard error of the means.

Carcass traits:

Results in Table (7) show that all carcass characteristics were not significantly affected by adding L-Val levels to LPD except abdominal fat percentage which was significantly affected. Chicks of the control group recorded significantly the lowest abdominal fat% while chicks fed LPD exhibited the highest value. All treatments fed L-Val supplemented diets recorded lower percentage of abdominal fat comparing to others fed LPD. These results are in agreement with Yamazaki *et al.* (2006), who found that excess amino acids supplementation to the low CP diet had little effect on abdominal fat (%) during the first three weeks of age in broilers .The possible mechanisms involved in decreasing abdominal fat after feeding high protein diets is related to increase of heat increment due to deamination and transamination of sulfur amino acids to other metabolites and finally uric acid. Rosebrough *et al.* (2002) concluded that in creasingdietary CP canlimit*in vitro*lipogenesis. They proposed that both of mRNA and posttranscriptional events act together to regulate lipogenesis in birds. Since ,nitrogen excretion is an energy-dependent process (Leeson and Summers, 2001), broilers fed diets with excess nitrogen will expend less energy for fat deposition (MacLeod, 1997).

Table 7. Effect of adding various levels of L-Valine to low-CP diets on carcass traits and meat quality of broiler chicks

Treatments	Slaughter parameters			Meat quality	
	Carcass yield %	Abdominal fat %	Giblets %	Thigh %	Boned breast %
T1 (Control)	73.2	1.06^{b}	4.72	28.8	39.5
T2 (LPD)	72.6	1.80^{a}	4.96	28.2	38.2
T3 (Val 250mg/kg)	72.9	1.54^{ab}	5.04	28.1	39.7
T4 (Val 500mg/kg)	72.4	1.52^{ab}	4.80	28.0	39.6
T5 (Val 750mg/kg)	72.8	1.28^{ab}	4.77	28.4	39.5
T6(Val 1000mg/kg)	73.0	1.46^{ab}	4.87	29.3	38.8
T7(Val 1250 mg/kg)	70.5	1.69^{a}	4.82	27.4	39.4
T8(Val 1500mg/kg)	71.4	1.79^{a}	4.93	27.8	38.6
SEM	3.15	0.059	0.047	2.07	2.18
P value	NS	0.035	NS	NS	NS

a-b: Means in each column, with common superscripts are not significantly different (P<0.05). LPD= low protein diet, NS= Not significant,SEM= Standard error of the means.

It appears that chicks fed the LPD supplemented with val displayed numerically higher boned breast % than those fed LPD alone. This may be due to that the bird's requirement for val was supported , since Val is of great importance in ensuring the optimal usage of lysine and thus increasing the breast meat yield (Berri *et al.,* 2008). Widyaratne and Drew (2011) observed that high breast meat yield requires a high-protein diet and is not affected by digestibility of nutrients . In harmony with the present results, Tavernari *et al.* (2013) concluded that there were no significant differences in carcass traits (carcass, breast and leg yields) related to the influence of Val:Lys ratio . Our results disagree with those ofCorzo *et al.* (2008), who found that the carcass weight , total boneless-skinless breast meat, and drumsticks were optimum when dietary Val level was 0.82, 0.82, and 0.83%, respectively.

Economic efficiency:

Effect of different added dietary L-Val levels to low-CP diets on economic efficiency are presented in Table 8. The results show that all groups recorded lower relative economic efficiency (REE) except those fed 500 mg Val/kg diet (103.2%) comparing to those fed the control diet (T1).Moreover, comparing to LPD (T2) chicks fed either 250 mg Val/kg diet or 500 mg Val/kg diet revealed the best REE being 104.4% and 114.2%, respectively.

Table 8. Effect of adding various levels of L-Valine to low-CP diets on economical efficiency

Item	T1	T2	T3	T4	T5	T6	T7	T8
Fixed price/chick (PT)				300				
Total feed cost (PT)/chick	1025.7	989.4	972.1	978.1	976.7	1046.5	1030.2	1095
Total cost PT (chick)	1325.7	1289.4	1272.1	1278.1	1276.7	1346.5	1330.2	1395
Average LBW (kg/bird)	1.868	1.713	1.733	1.827	1.608	1.722	1.664	1.672
Price/kg LBW (PT)				1600				
Total revenue (PT)/chick	2988.8	2740.8	2772.8	2923.2	2572.8	2755.2	2662.4	2675.2
Net revenue	1663.1	1451.4	1500.7	1645.1	1296.1	1408.7	1332.2	1280.2
Economic efficiency (%)	125	113	118	129	102	105	100	92
Relative ecomonic efficiency (REE)	100	90.4	94.4	103.2	81.6	84.0	80.0	73.6

CONCLUSION

1- The most excellent inclusion level of L.Valineto theLPD is 500 mg/kg diet which gave the best results for both body weight gain and FCR.
2- Supplementation of the LPD with 500 mg Val/kg diet led to the best economic efficiency being 103.2% and 114.2% as compared to the recommended CP level for the Arbor Acres broilers diet and LPD respectively.

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استجابة كتاكيت التسمين للعلائق المنخفضة فى محتواها من البروتين ومضاف اليها الفالين ومكونة على اساس الاحماض الامينية المهضومة

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صممت هذه الدراسة لتقييم تأثير اضافة مستويات مختلفة من الحامض الامينى فالين للعلائق المنخفضة فى محتواها من البروتين على الاداء الانتاجى وصفات الذبيحة والمغذيات المهضومة والكفاءة الاقتصادية لكتاكيت سلالة اربور ايكرز. استخدم عدد٦٤٠ كتكوت اربور ايكرز غير مجنس عمر يوم حيث قسمت الطيور الى ٨ معاملات متساوية بكل منها ٨٠ طائر(١٠ طائر/مكرر) وقد استخدمت المعاملة الاولى كمجموعة مقارنة (حيث احتوت على احتياجات السلالة من البروتين)٢٣%و ٢١% و ١٩% بروتين خام و ٠.٩٦, ٠.٨٨, ٠.٧٩% فالين مهضوم خلال مراحل البادى والنامى والناهى على التوالى بينما تم خفض نسبة البروتين بمعدل ٣% عن الكنترول (المعاملة الثانية) بحيث احتوت على٢٠%و ١٨% و ١٦% بروتين خام و٠.٨٩, ٠.٧٩, ٠.٦٩% فالين مهضوم خلال المراحل الثلاثة للنمو السابق ذكرها. بينماتغذت باقى المعاملات على عليقة المجموعة الثانية ومضاف اليها الفالين بمستويات ٢٥٠, ٥٠٠, ٧٥٠, ١٠٠٠, ١٢٥٠, ١٥٠٠ملليجرام /كجم علف. وقد استمرت الدراسة حتى ٣٨ يوم. وكانت اهم النتائج هى:١- سجلت الطيور المغذاة على علائق منخفضة بالبروتين ومضاف اليها ٥٠٠ملليجرام فالين/كجم علف وكذلك مجموعة الكنترول أفضلوزن جسم مكتسبو كفاءة تحويل غذائىخلال فترة الدراسة كاملة بدون فروق معنوية بينهم.٢- تراوح معامل هضم الفالين بين ٩١.١٧ الى ٩٧.٠٣%.٣-حققت الطيور المغذاة على عليقة المقارنة أقل نسبة لدهن البطن مقارنة بالطيور المغذاة على علائق منخفضة بالبروتين سواء مضاف أو غير مضاف اليها فالين.٤- سجلت الطيور المغذاة على علائق منخفضة البروتين ومضاف اليها ٥٠٠ملليجرام فالين/كجم علف أفضل كفاءة اقتصادية ١٠٣.٢% , ١١٤.٢% مقارنة بمجموعة الكنترول والمجموعة منخفضة البروتين. الخلاصة: حققت الطيور المغذاة على علائق منخفضة البروتين وتغطى الاحتياجات الغذائية من المثيونين والليسين والثريونين ومضاف اليها ٥٠٠ملليجرام فالين/كجم علف أفضل نسبة فالين/ليسين خلال مراحل البادى والنامى والناهى بالاضافة لتحقيق أفضل كفاءة اقتصادية.