飼糧中添加離胺酸與甲硫胺酸對北京鴨屠體性狀之評估(1)

賴銘癸(2) (4)　林誠一(3)　林榮新(3)　黃振芳(3)

收件日期：91 年 8 月 19 日；接受日期：91 年 11 月 18 日

摘　　要

北京鴨第 4 週齡開始進行飼養試驗，試驗分爲 3 個處理組，各處理之飼糧其粗蛋白質與代謝能含量均相同，分別爲 15%與 3000 kcal/kg；離胺酸含量分別爲 0.9%、1.2%與 1.5%； 1.2%與 1.5%處理組之甲硫胺酸含量均等比例提高。每處理組 5 重複，每重複公母各 10 隻，共計 300 隻。試驗至 10 週齡結束，試驗期間測定 5、7 及 10 週齡之增重、採食量、飼料利用效率，第 7 與 10 週齡時每重複犧牲公母各 2 隻供測定屠體組成、胸肉組成分、胸肉之蒸煮失重、剪切值及官能品評。

試驗結束之體重、各階段增重、採食量及飼料利用效率處理間均無明顯差異，但 1.5%離胺酸組之增重與飼料利用效率均有較佳的趨勢。7 週齡以後之增重速率與飼料利用效率明顯變差，7 週齡與 10 週齡之屠體重僅相差 609 g，而胸肉重即增加 297 g。10 週齡之屠宰率 1.5%組較 0.9%組佳 （$P < 0.05$）。腿瘦肉重量 1.5%組顯著較 1.2%組高（$P < 0.05$）。10 週齡各部位之屠體重除腿瘦肉較 7 週齡輕外其餘均較高。胸肉組成分處理間無明顯差異，7 週齡水分含量較多，10 週齡蛋白質含量較高（$P < 0.05$）。剪切值、蒸煮失重處理間亦無顯著差異，10 週齡蒸煮失重顯著較 7 週齡少，7 週齡之剪切值較高（$P < 0.05$）。

關鍵詞：北京鴨、離胺酸、甲硫胺酸、屠體性狀。

緒　　言

本省地處亞熱帶，夏季高溫多濕，除影響鴨隻的生長外，屠體品質亦顯著降低，尤以胸肉重量嚴重減輕，連帶影響加工產品的品質。依沈（1988）推薦，肉鴨餵飼玉米-大豆粕飼糧中之第一限制胺基酸爲含硫胺基酸，一般商用飼糧中皆會添加 DL-甲硫胺酸以滿足推薦標準。離胺酸通常爲第二限制胺基酸，一般飼料原料中離胺酸的生物利用率約爲 85%，但不良的加工過程會降低其利用率，而合成之 L-Lysine•HCl 其消化率及生物可利用率幾乎可達 100%（Izquierdo *et al*., 1988）。爲提高胸肉重量，肉雞餵飼高蛋白質與高離胺酸飼糧，胸肉重量明顯提高（Holsheimer and Veerkamp, 1992）。

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(1)　行政院農業委員會畜產試驗所研究報告第 1147 號。

(2) 行政院農業委員會畜產試驗所經營組。
(3) 行政院農業委員會畜產試驗所宜蘭分所。
(4) 通訊作者。

Surisdiarto and Farrell（1991）指出，隨著日糧離胺酸含量的增加，增重及飼料利用效率均獲得顯著改善，顯然是因含高量蛋白質所產生的效果，另外也有可能是供應足夠量的合成胺基酸，肉雞可由此獲得足夠的胺基酸以瀰補個別胺基酸供應的不足，因此，額外添加離胺酸較餵給"理想胺基酸"飼糧者胸肉重量顯著增加。能量在體內以脂肪或以蛋白質的形式滯留，兩者之間呈直線相關，但其斜率則取決於離胺酸的含量（Sibbald and Wolynetz, 1986）；可見離胺酸在蛋白質蓄積方面扮演極重要的角色。

我國加入世界貿易組織後，未來進口鴨肉可能對肉鴨產業造成極大的衝擊，市場需求的鴨肉爲胸肉大，脂肪少。由於北京鴨後期飼糧常提高能量以滿足最佳增重及飼料利用效率，因此常有過多脂肪堆積。國內屠宰廠商爲獲得較大的胸肉，要求北京鴨必須飼養至 75 日齡才可上市，但該鴨種生長至 7 週齡以後效率轉差，飼養上極不經濟，鴨農時有怨言。於此生長階段添加合成離胺酸期能提高瘦肉率，增加胸肉產量使鴨隻得以提前上市。

材料與方法

Ⅰ. 試驗設計與飼糧調製

北京雛鴨購自商用種鴨場，於 88 年 11 月 3 日孵化。試驗期間分 2 階段飼養，即育雛期（0-3 週）與生長肥育期（3-10 週）。育雛期均餵飼含粗蛋白質 18%，代謝能 2900 kcal/kg 之飼糧。自第 4 週齡起開始進行試驗，試驗分爲 3 個處理組，飼糧組成如表 1 所示，各組飼糧等蛋白等能量，粗蛋白質與代謝能之含量分別爲 15%與 3000 kcal/kg，離胺酸含量分別爲 0.9%（NRC, 1994）、1.2%及 1.5%，1.2%與 1.5% 處理組之甲硫胺酸含量均等比例提高。每處理 5 重複，每重複 20 隻，公母各半，共計 300 隻。試驗期間採平飼，飼料及飲水自由採食。

Ⅱ. 資料收集

記錄 5、7 及 10 週齡之增重、飼料消耗量及飼料利用效率，第 7 與 10 週齡時每重複犧牲公母各 2 隻供測定屠宰率、分切屠體各部位重量。

Ⅲ. 一般化學成分分析

胸肉之水分、粗蛋白質、粗脂肪及灰分依 A.O.A.C（1980）法行之。

Ⅳ. 蒸煮失重（Cooking loss）

胸肉懸掛於燻煙蒸氣機內，以 85℃蒸氣蒸煮 40 分鐘，俟冷卻後計算蒸煮前後之失重。

Ⅴ. 剪切值（Shear value）

蒸煮後同一部位之胸瘦肉，切成長 3 cm ×寬 1 cm ×高 1 cm 之長條型，以 Warner-Bratzler 剪力儀測定。

Ⅵ. 官能品評（Sensory evaluation）

以 7 位經訓練之品評員就蒸煮鴨胸肉之質地、色澤、風味及總可接受性以 9 分評分法予以品評評分（9 分表最好；5 分表普通；1 分表最差）。

Ⅶ. 統計分析

試驗結果所得之各項數值，採用 SAS（1988）套裝軟體之一般線性模式程序進行變方分析，並以鄧肯氏新多變域法（Duncan’s new multiple range test）比較處理間之差異顯著性(Steel and Torrie, 1980)。

表 1. 試驗飼糧組成

Table 1. The composition of the experimental diets

Ingredients	Starter (0－3 week of age)	Treatment (3－10 week of age)		
		0.9%	1.2%	1.5%
Corn, yellow	66.2	71	71	71
Soybean meal, 44% CP	23.6	19	19	19
Fish meal	2	-	-	-
Wheat bran	2	1	1	1
Rice hull	1.95	3.07	2.58	2.09
Soybean oil	0.67	1.9	1.9	1.9
Yeast	0.85	1	1	1
Limestone, pulverized	0.05	0.2	0.2	0.2
Dicalcium phosphate	1.6	1.8	1.8	1.8
Vitamin premix [a]	0.3	0.3	0.3	0.3
Mineral premix [b]	0.2	0.2	0.2	0.2
DL-Methionine	0.08	0.05	0.16	0.27
L-Lysine	0.2	0.18	0.56	0.94
Salt	0.3	0.3	0.3	0.3
Total	100	100	100	100
Calculated value				
Crude protein, %	18.00	15.00	15.00	15.00
ME, kcal/kg	2902	3002	3002	3002
Calcium, %	0.73	0.73	0.73	0.73
Total phosphorous, %	0.66	0.62	0.62	0.62
Available phosphorous, %	0.54	0.52	0.52	0.52
Methionine, %	0.41	0.32	0.43	0.54
Met+Cys, %	0.70	0.57	0.68	0.79
Lysine, %	1.14	0.90	1.20	1.49
Tryptophan, %	0.22	0.19	0.19	0.19
Threonine, %	0.76	0.65	0.65	0.65
Analyzed value				
Crude protein, %	-	14.37	14.30	14.89
Calcium, %	-	0.70	0.77	0.75
Total phosphorous, %	-	0.62	0.62	0.64
Met+Cys, %	-	0.50	0.57	0.66
Lysine, %	-	0.86	1.07	1.33

[a] Vitamins supplementation per kg of diet: Vitamin A 10,000 IU; Vitamin $D_{3,}$ 1,000IU; Vitamin E, 25 IU; Vitamin K, 3 mg; Thiamin, 3 mg; Riboflavin, 5 mg; Pyridoxine, 3 mg; Vitamin B_{12}; 0.03 mg; Ca-pantothenate, 10 mg; Niacin, 50 mg; Biotin (1.0), 0.1 mg; Folic acid, 3 mg; Choline-Cl (50%), 1,000 mg.

[b] Min-premix supplementation per kg of diet: Mn, 60 mg($MnSO_4.H_2O$); Zn, 60 mg (ZnO); Cu, 5 mg ($Cu_2SO_4.5H_2O$); Se, 0.1 mg (Na_2SeO_3).

結果與討論

北京鴨自第 4 週齡起餵飼試驗日糧，額外添加合成離胺酸及甲硫胺酸對增重並無顯著改善（表 2），飼料消耗量各處理之間差異甚小（表 3），飼料利用效率亦無顯著差異，但 1.5%組之增重與飼料利用效率均有較佳的趨勢，尤以生長後期（7~10 週齡）之效率最佳。Adams *et al.*（1983）的研究結果顯示，飼糧中離胺酸的含量範圍自 0.70%至 1.00%，餵飼北京鴨至 48 或 49 日齡上市時對增重或飼料利用效率均無顯著影響。Holsheimer and Veerkamp（1992）指出，離胺酸與飼糧中粗蛋白質含量有交感作用存在，肉雞餵飼含正常蛋白質加上高離胺酸之飼糧增重最佳，但大部份的交感於 8 週齡時消失。Si *et al.*（2001）餵飼肉雞，以複因子排列（4 Lysine × 4 EAA）評估離胺酸與多種必需胺基酸之相關，結果發現，生長性能和屠體性狀在離胺酸與多種必需胺基酸之間並無交感效應，其認爲 NRC（1994）推薦之離胺酸與其他必需胺基酸的含量可使飼養至 56 日齡才上市的公肉雞獲得最佳的生長性能，但較不適合年輕的雞隻。D'Mello（1988）的研究結果顯示，蛋白質含量相同的飼糧，給予高離胺酸之雞隻較一般含量者在 6、7 與 8 週齡之增重均較佳，但飼料利用效率無顯著影響。火雞餵飼高精胺酸與離胺酸比之飼糧時，一直到 14 週齡體增重才顯著增加（Veldkamp *et al*., 2000）。本試驗添加高離胺酸組在後期的增重亦呈較佳的趨勢。北京鴨的生長速率較肉雞遲緩，最有利的上市時期應在 50 日齡左右，第 8 至第 10 週齡之增重速率明顯減緩，此 3 週間的日增重較 3-5 與 5-7 週的增重還少，而且飼料利用效率亦顯著變差，在效益上甚不經濟；然而，屠宰業者認爲 50 日齡鴨隻的屠體品質不佳，皮多瘦肉少，這也是爲何飼養業者與屠宰業者之間存在著很大隔閡的原因。Surisdiarto and Farrell（1991）發現，隨著日糧離胺酸含量的增加，增重及飼料利用效率均獲得顯著改善，顯然主要是含高量蛋白質所產生的效果，另外也有可能是供應足夠量的合成胺基酸，肉雞可利用這些胺基酸來滿足個別胺基酸的需要，因此，額外添加離胺酸較餵給理想胺基酸（Ideal amino acid）飼糧之處理組顯著增加胸肉重量。結晶型胺基酸已普遍應用於飼料的添加，使用結晶型胺基酸讓營養學家在調配飼料時可使胺基酸超量的情形減至最低（Han *et al*., 1992）。胺基酸過量反而造成生長的傷害，Han and Baker（1993）的結果顯示，玉米-大豆粕飼糧中離胺酸添加量高達 4%時，使肉雞的增重減少 50%，過剩的離胺酸傾向於抑制飼料攝取量而不會直接影響增重。Edmonds and Baker（1987）發現肉雞接受甲硫胺酸與離胺酸超過量未達 1%時對增重或飼料利用效率並無不利的影響，但超過 1%以上時之增重則顯著受抑制，當離胺酸超過 3%時增重與 1%一樣，並未持續減少。蛋雞玉米-大豆粕飼糧中額外添加 1%離胺酸並不影響產蛋性能，因而認爲產蛋雞對個別過剩的胺基酸存在著相當程度的耐受性（Koelkebeck *et al*., 1991）。Abebe and Morris（1990）表示，飼糧中離胺酸的需要量應該是指與蛋白質的比例而不應是佔日糧比例。

表 2. 不同離胺酸與甲硫胺酸濃度對北京鴨生長性能之影響

Table 2. Effects of different dietary lysine and methionine levels on growth performance of Pekin ducks

Treatment	Body weight gain (g)					
	Weight		Gain			
	Initial	End	3-5 wk	5-7 wk	7-10 wk	3-10 wk
0.9%	869 ± 111	3805 ± 488	1056 ± 236	102 3± 203	785 ± 260	2864 ± 458

1.2%	844 ± 127	3741 ± 489	1085 ± 183	994 ± 216	786 ± 328	2875 ± 466
1.5%	848 ± 116	3914 ± 441	1110 ± 175	1016 ± 228	882 ± 312	3066 ± 425

表 3. 不同離胺酸與甲硫胺酸濃度對北京鴨飼料消耗量與飼料利用效率之影響

Table 3. Effects of different dietary lysine and methionine levels on feed consumption and feed efficiency of Pekin ducks

Treatment	Week of age			
	3-5	5-7	7-10	3-10
	Feed consumption (kg)			
0.9%	2.63 ± 0.24	2.40 ± 0.26	4.94 ± 0.71	9.98 ± 0.55
1.2%	2.62 ± 0.16	2.37 ± 0.26	4.86 ± 0.78	9.85 ± 0.53
1.5%	2.61 ± 0.06	2.40 ± 0.34	4.71 ± 0.56	9.71 ± 0.42
	Feed efficiency (feed/gain)			
0.9%	2.48 ± 0.18	2.34 ± 0.35	6.38 ± 1.13	3.42 ± 0.26
1.2%	2.42 ± 0.10	2.38 ± 0.36	6.11 ± 0.96	3.40 ± 0.25
1.5%	2.35 ± 0.10	2.36 ± 0.33	5.37 ± 0.60	3.20 ± 0.16

不同離胺酸與甲硫胺酸濃度對北京鴨屠體各部位之重量影響不顯著（表 4），10 週齡腿瘦肉重量以 1.5%組最重，1.2%組則最輕（$P < 0.05$）；10 週齡屠體各部位的重量除腿瘦肉外其餘都較 7 週齡重，尤以胸瘦肉增加的比率最高，佔屠體總增重的 49%（297 g / 609 g）。屠宰率 1.5%組最高，0.9%組最低（$P < 0.05$）。Adams *et al.*（1983）指出，北京公鴨之飼糧中離胺酸含量在 0.80-0.95%之間，母鴨在 0.90%時，瘦肉之總產量明顯增加。本試驗飼糧中離胺酸含量均在 0.9%以上，胸瘦肉於各處理間均無顯著差異，可能係因其含量已達最佳瘦肉生產所需。肉雞的試驗結果則顯示，含高量離胺酸使胸肉的產量增加（Holsheimer and Veerkamp, 1992）。肉雞飼養 37 天與 51 天之屠體組成，其肌肉較多的部分，如腿、前四分體、胸及里脊肉等均隨日齡增長而增加重量（Young *et al*., 2001），皮及脂肪亦隨之增加，但可食性內臟、翅膀及頸部比率則減少（Holsheimer and Veerkamp, 1992）。北京鴨屠體各部位分切重量及可食性內臟重量至 10 週齡時大多持續增加，肌肉增重最多，這也就是國內屠宰廠商一直堅持要養鴨農戶飼養至 75 日齡以上才宰殺的原因。

胸肉之組成分於處理間均無顯著差異（表 5），7 週齡之水分含量較 10 週齡爲高，蛋白質的含量則較 10 週齡低，灰分及脂肪差異不大。在肉雞方面卻有不同的結果，Sibbald and Wolynetz（1986）估算飼糧離胺酸濃度與體組成之相關，發現離胺酸含量增加，屠體蛋白質隨之增加，高離胺酸組之體脂肪最低。不同品系肉雞在 4-6 週齡間餵飼含 0.85%~1.05%離胺酸之飼糧，亦獲同樣結果（Moran and Bilgili, 1990）。Gous and Morris （1985）表示，肉雞飼糧中離胺酸的含量自 6 g/kg 至 16 g/kg，屠體脂肪自 18%減至 8%。含低濃度離胺酸飼糧會延緩小雞肝臟蛋白質重組的速率（Akinwande and Bragg, 1985），使肉雞的肌肉重量減輕（Tesseraud *et al.*, 2001）。離胺酸缺乏之飼糧亦使老鼠肝臟內蛋白質的合成受到抑制（Canfield and Chytil, 1978）。

表 4. 不同離胺酸與甲硫胺酸濃度對北京鴨屠體各部位重量之影響 (g)

Table 4. Effects of different dietary lysine and methionine levels on various parts of carcass weight of Pekin ducks (g)

Treatment	Live body	Carcass	Head & Neck	Wing	Gizzard	Abdominal fat	Breast meat	Lean breast meat	Thigh meat	Lean thigh meat	Dressing Percentage (%)
					7 week of age						
0.9%	2947±57	2160±48	320±32	191±14	109±12	37.1±10 (1.72±0.5)	543±43 (25.1±2.0)	258±27 (11.9±1.2)	459±29 (21.2±1.2)	263±30 (12.2±1.4)	73.3±1.3
1.2%	2939±60	2166±60	330±30	201±18	114±8	36.8±11 (1.70±0.5)	545±37 (25.1±1.6)	254±32 (11.7±1.3)	478±26 (22.1±1.3)	264±19 (12.2±1.0)	73.7±1.7
1.5%	2956±54	2151±65	325±24	189±19	109±11	30.8±6.4 (1.43±0.3)	555±45 (25.8±1.6)	274±31 (12.7±1.3)	467±25 (21.7±1.1)	268±21 (12.5±1.0)	72.8±1.7
Mean	2947±55^{B}	2159±56^{B}	325±30^{B}	194±17^{B}	111±12^{B}	34.9±9.4^{B} (1.61±0.4)	547±45^{B} (26.4±1.7)	284±37^{B} (12.2±1.6)	468±33^{B} (21.7±1.5)	265±29 (12.3±1.1)	73.3±1.5^{B}
					10 week of age						
0.9%	3643±244	2715±191	416±35	215±16	124±18	53.1±18 (1.95±0.7)	821±89 (30.2±2.1)	458±40 (16.9±1.2)	541±51 (19.9±1.4)	258±18^{ab} (9.5±0.6)^{a}	74.5±1.4^{b}
1.2%	3647±148	2780±102	410±37	215±24	112±13	55.4±16 (1.99±0.6)	873±54 (31.4±1.7)	490±60 (17.6±1.9)	545±50 (19.6±1.7)	243±16^{b} (8.8±0.6)^{b}	76.2±1.2^{ab}
1.5%	3627±217	2808±140	416±34	225±22	123±27	52.0±11 (1.85±0.4)	838±76 (29.8±2.2)	476±62 (16.9±1.6)	535±47 (19.0±1.5)	266±30^{a} (9.4±1.1)^{ab}	77.6±5.1^{a}
Mean	3639±200^{A}	2768±119^{A}	413±34^{A}	218±21^{A}	120±20^{A}	53.5±15^{A} (1.93±0.5)	844±76^{A} (30.2±2.0)	475±55^{A} (17.1±1.6)	540±49^{A} (19.5±1.5)	256±29 (9.3±1.0)	76.1±3.3^{A}

$^{a, b}$ Means within the same column and same week of age with different letters are significantly different ($P < 0.05$).

$^{A, B}$ Means within the same column with different letters are significantly different ($P < 0.05$).

( ): Parameter in parentheses means the percentage of the part weight to carcass weight.

胸肉的蒸煮失重及剪切值處理間亦無明顯差異（表 6）。Moran and Bilgili（1990）指出，肉雞的蒸煮失重與飼糧中離胺酸的含量無關。7 週齡之蒸煮失重較 10 週齡多，與胸肉之水分含量較高及保水性較差有關。7 週齡之剪切值較 10 週齡爲高（$P < 0.05$）。蒸煮過之胸肉經品評結果，風味、多汁性、質地及總可接受性之品評評分各處理組及週齡間均無顯著差異（表 7），顯示在 7 週齡或 10 週齡屠宰時肉質均在可接受的範圍。

表 5. 不同離胺酸與甲硫胺酸濃度對北京鴨胸肉組成分之影響（%）

Table 5. Effects of different dietary lysine and methionine levels on breast meat composition of Pekin ducks（%）

Treatment	Moisture	Ash	Protein	Lipid
	7 week of age			
0.9%	78.5 ± 0.8	1.54 ± 0.22	19.5 ± 0.6	0.65 ± 0.19
1.2%	78.5 ± 0.6	1.50 ± 0.13	19.8 ± 1.4	0.42 ± 0.26
1.5%	78.5 ± 0.8	1.53 ± 0.18	20.4 ± 1.2	0.52 ± 0.35
Mean	78.5 ± 0.7^{A}	1.52 ± 0.18	19.9 ± 0.12^{B}	0.53 ± 0.28

	10 week of age			
0.9%	74.8 ± 0.8	1.55 ± 0.12	22.0 ± 2.0	0.48 ± 0.18
1.2%	75.2 ± 1.1	1.52 ± 0.10	22.8 ± 0.7	0.44 ± 0.34
1.5%	74.5 ± 0.6	1.52 ± 0.07	22.8 ± 0.5	0.42 ± 0.38
Mean	74.8 ± 0.9 [B]	1.53 ± 0.10	22.5 ± 1.3 [A]	0.45 ± 0.30

[A, B] Means within the same column with different letters are significantly different (P < 0.05).

表 6. 不同離胺酸與甲硫胺酸濃度對北京鴨 7 與 10 週齡胸肉蒸煮失重與剪切值之影響

Table 6. Effects of different dietary lysine and methionine levels on cooking loss and shear value of the breast meat of Pekin ducks at 7 and 10 weeks of age

Treatment	Cooking loss (%)	Shear value (kg)
	7 week of age	
0.9%	45.0 ± 2.0	1.43 ± 0.32
1.2%	44.0 ± 1.0	1.37 ± 0.42
1.5%	43.5 ± 2.7	1.37 ± 0.27
Mean	44.2 ± 2.5[A]	1.39 ± 0.33[A]
	10 week of age	
0.9%	39.1 ± 2.2	1.12 ± 0.26
1.2%	39.3 ± 2.5	1.24 ± 0.42
1.5%	38.3 ± 2.1	1.22 ± 0.31
Mean	38.9 ± 2.3[B]	1.19 ± 0.35[B]

[A, B] Means within the same column with different letters are significantly different (P < 0.05).

表 7. 飼糧中添加離胺酸與甲硫胺酸之北京鴨 7 與 10 週齡胸肉之品評評分表

Table 7. Effects of different dietary lysine and methionine levels on panel test score of the breast meat of Pekin ducks at 7 and 10 weeks of age

Treatment	Flavor*	Juicy	Texture	Over-all acceptance
	7 Week of age			
0.9%	6.9 ± 1.4	6.9 ± 1.5	6.7 ± 1.2	6.8 ± 1.4
1.2%	6.6 ± 1.3	6.0 ± 1.4	6.2 ± 1.2	6.3 ± 1.3
1.5%	7.3 ± 1.9	7.0 ± 1.8	7.3 ± 1.3	7.2 ± 1.8
Mean	6.9 ± 1.5	6.3 ± 1.6	6.7 ± 1.2	6.8 ± 1.5
	10 Week of age			
0.9%	6.9 ± 1.0	6.7 ± 0.9	6.9 ± 0.9	7.1 ± 1.1
1.2%	6.7 ± 1.3	7.2 ± 1.5	7.2 ± 1.2	7.2 ± 1.1
1.5%	7.2 ± 1.1	7.4 ± 1.0	7.3 ± 0.9	7.5 ± 1.0
Mean	6.9 ± 1.2	7.1 ± 1.5	7.1 ± 1.1	7.3 ± 1.1

*Panel evaluation : 9 excellent, 5 fair, 1 extremely poor.

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Effects of dietary lysine and methionine levels on the carcass traits of Pekin ducks[1]

Ming-Kuei Lai[2] [4], Chung-Yi Lin[3], Rong-Hsin Lin[3] and Jeng-Fang Huang[3]

Received：Aug. 19, 2002；Accepted：Nov. 18, 2002

Abstract

Pekin ducks at 3 weeks of age were randomly assigned to three levels of dietary lysine: 0.9, 1.2, and 1.5%, respectively. The content of dietary methionine was enhanced proportionally in 1.2 and 1.5% treatments. An isonitrogenous and isocaloric diet with CP 15% and ME 3000 kcal/kg was given to ducks in all treatments. There were 5 replicates in each treatment, with 10 males and 10 females in each replicate. Body weight, feed intake, and feed efficiency were recorded at 5, 7, and 10 weeks of age. At 7 and 10 weeks of age, two ducks from each replicate were sacrificed to investigate the carcass traits, including approximate composition, cooking loss, shear value, and sensory evaluation of breast meat.

At the end of this study, no differences were observed in the body weight, body weight gain, feed intake, and feed efficiency. However, the 1.5% group had a trend of higher body weight gain and better feed efficiency. The body weight gain and feed efficiency worsened significantly after 7 weeks of age. Between 7 and 10 weeks of age, carcass and breast weight increased 609 and 297 g, respectively. The dressing percentage of ducks in the 1.5% group was significantly better than that of 0.9% group（$P < 0.05$）. The lean thigh meat in the 1.5% group was significantly higher than that of 1.2% group. The weights of dissected parts at 10 weeks of age were heavier than those at 7 weeks of age, except for the lean thigh meat. The approximate composition of breast meat was similar among treatments. There was higher percentage of water and lower percentage of crude protein at 7 weeks than that at 10 weeks of age. The shear value and cooking loss were also similar among treatments. The cooking loss at 10 weeks of age was less than that at 7 weeks of age（$P < 0.05$）； however, opposite tendency was observed in the aspect of shear value.

Key words：Pekin duck, Lysine, Methionine, Carcass trait.

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(1) Contribution No. 1147 from Livestock Research Institute, Council of Agriculture, Executive Yuan.
(2) Livestock Management Division, COA-LRI, Hsinhua 712, Taiwan, R.O.C.
(3) Ilan Branch, COA-LRI, Ilan 268, Taiwan, R.O.C.
(4) Corresponding author.