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飼糧中添加抗生素對肉雞腸道組織形態及雙醣酶活性之影響 (1)

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摘　要

本試驗旨在研究抗生素促進肉雞生長的機制，以及對腸道雙醣酶活性和組織形態的作用。選取 192 隻一日齡愛拔益加肉雛雞，逢機分為對照組 (control)、55 ppm 枯草菌素 (bacitracin)、2.5 ppm 六肽黴素 (nosiheptide) 及 55 ppm 羥四環黴素 (oxytetracycline, OTC) 四組。公母混飼，每處理組 4 重複，每重複 12 隻。分別於 3 週及 6 週時，進行腸道組織型態及消化酵素活性測定。結果顯示，肉雞飼糧中添加枯草菌素或六肽黴素於 3 週及 6 週齡之體增重皆顯著高於對照組 ($P < 0.05$)，而添加羥四環黴素組至 6 週齡時才有促進增重之效果 ($P < 0.05$)。飼糧中添加枯草菌素及六肽黴素有增加 3 週齡雞隻腸道雙醣酶的活性之趨勢 ($P < 0.1$)。添加枯草菌素於 6 週齡時，顯著增加迴腸絨毛高度，以及空腸及迴腸絨毛高度與腺窩之比例 ($P < 0.05$)，添加六肽黴素減少 3 週齡迴腸黏膜肌層厚度及 6 週齡空腸腺窩深度，同時減少空腸絨毛長度與腺窩之比例 ($P < 0.05$)，相反的，羥四環黴素則顯著提高 3 週齡時空腸腺窩深度及黏膜肌層厚度。飼糧中添加抗生素不影響腸道醣類酵素活性，枯草菌素和六肽黴素對肉雞生長促進的作用可能是由於改善腸道形態所致。

關鍵詞：白肉雞、抗生素、雙醣酶活性、腸道組織形態。

緒　言

家禽生產多採密集飼養，而低劑量抗生素一直被使用於促進動物之生長。在緊迫及病原種類繁多之環境下，業者會有添加抗生素於飼糧中來改善雞隻生產表現之情形。2010 年美國調查對動物施用的 1,300 萬公斤抗生素中，大多數用於促進畜禽的生長 (Spellberg *et al.*, 2013)。添加抗生素於飼料中，雖可抑制家禽腸道中之有害微生物，促進生長與改善飼料利用效率，但卻會引起抗藥性菌株的產生與造成畜產品中藥物殘留等問題。歐盟已於 2006 年全面禁止畜禽養殖業者在動物飼料中使用促進生長用抗生素，在美國也逐步減少促進生長用抗生素的使用 (EC, 2003; FDA, 2012)，禁用或限用抗生素已成為全球之趨勢。因此，找尋取代抗生素替代物質，為近年來畜牧生產之研究重點。

腸道完整性在維持離子、營養物質吸收和水的滲透性，以及限制細菌毒素和病原體的入侵方面扮演重要功能 (Rescigno, 2011)。腸道完整性的喪失導致屏障通透性的增加，被認為是導致代謝紊亂，腸炎和肥胖症的原因 (Connell *et al.*, 2013; Chelakkot *et al.*, 2018)。使用抗生素會影響腸道結構 (Miles *et al.*, 2006; Awad *et al.*, 2015)。研究指出雞隻飼糧中添加純黴素 (virginiamycin) 及枯草菌素於 3 週齡時減少肉雞小腸重量 (Henry *et al.*, 1987)；餵飼羥四環黴素 (oxytetracycline) 及枯草菌素會減少雞隻小腸的長度 (Fethiere and Miles, 1987)。Miles *et al.* (2006) 指出添加純黴素減少迴腸黏膜肌層厚度、絨毛面積、絨毛高度及腺窩深度，而枯草菌素則皆無顯著影響，這些結果顯示，添加不同的抗生素可能對腸道形態造成不同的影響。

雞隻飼料原料含大量的碳水化合物，碳水化合物必須消化成單糖後，才能被小腸吸收。Siddons (1972) 指出，餵飼碳水化合物之基礎飼糧，小腸麥芽糖酶及蔗糖酶活性遠高於蔗糖－異麥芽糖酶 (sucrose-isomaltase) 及乳糖酶，表示麥芽糖酶及蔗糖酶在雞隻之碳水化合物的消化有一定的重要性。此外，在培養液中添加紅黴素 (erythromycin)，

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會抑制小腸吸收羥丁胺酸 (L-threonine) 及半乳糖 (D-galactose)，推測紅黴素作用於運輸 L- 羥丁胺酸及 D- 半乳糖的鈉依賴性運輸器上 (Na^+-dependent transport)，改變腸道離子電流進而抑制空腸對 L- 羥丁胺酸及 D- 半乳糖的吸收 (Navarro *et al.*, 1992; Navarro *et al.*, 1993)。

枯草菌素、六肽黴素及羥四環黴素具有不同的抗菌圖譜，前二者對於革蘭氏陽性細菌具有明顯的抑菌及殺菌作用，後者為廣譜性抗生素，這些抗生素的使用都與家禽業有關，它們通常用於治療呼吸道、腸道細菌性下痢及促進生長，對家畜禽業的發展具有重要性 (Diarra and Malouin, 2014)。儘管枯草菌素、六肽黴素及羥四環黴素的抗生素特性已廣為人知，但尚未確定它們對家禽腸道功能的特定作用。此外，仍有其他國家作為促進生長用之抗生素。因此，本研究旨在評估此三種抗生素對提高肉雞生產性能的影響，並探究其添加在飼料中對雞隻腸道形態、消化酵素與生長促進之關連性。

材料與方法

I. 試驗動物與飼養管理

所有實驗動物程序均經國立臺灣大學實驗動物管理與使用委員會批准。自商業孵化場購入 1 日齡愛拔益加白肉雛雞 192 隻，平均分入 4 組，分別為飼料不加抗生素的對照組、枯草菌素添加組 (55 ppm)、六肽黴素添加組 (2.5 ppm) 及羥四環黴素添加組 (55 ppm)。公母混飼，每處理組 4 重複，每重複 12 隻，試驗為期 6 週。試驗期間飲水與飼料皆任飼，飼糧組成如表 1。試驗期間分別於 3 週齡及 6 週齡試驗結束時，每組犧牲 8 隻雞，採集腸道進行分析，在第 21 天和第 42 天，收集每隻雞的近端空腸粘膜 (十二指腸空腸交界處後 4 － 6 cm 處) 及遠端迴腸 (盲腸結直腸交界處前 6 － 8 cm) 用於雙醣酶測定。此外，取近端空腸 (十二指腸空腸交界處後面 6 － 8 cm 處) 和遠端迴腸 (盲腸－結直腸交界處前 4 － 6 cm) 進行組織形態分析。

表 1. 肉雞飼糧中添加抗生素之配方組成

Table 1. The composition of basal diets in broiler

Ingredients	0 － 3 wk	4 － 6 wk
	%	
Yellow corn, grain	48.80	57.30
Soybean meal, 44%	34.78	29.64
Fish meal, 65%	5.00	2.80
Soybean oil	7.65	6.40
Dicalcium phosphate	1.10	1.38
Calcium carbonate	1.30	1.31
DL-methionine	0.30	0.32
Choline-chloride, 50%	0.07	0.05
Vitamin premix[a]	0.30	0.30
Mineral premix[b]	0.20	0.20
Salt	0.50	0.30
Total	100	100
Calculated value		
Crude protein, %	23.00	20.10
ME, kcal/kg	3,344	3,325
Calcium, %	1.03	1.00
Available phosphorus, %	0.46	0.45

[a] Vitamin premix supplied per kilogram of diet: vitamin A, 12,000 IU; vitamin D_3, 3,125 ICU; vitamin E, 37.5 IU; vitamin K_3, 6.25 mg; vitamin B_1, 3.75 mg; vitamin B_2, 12.5 mg; vitamin B_6, 10.0 mg; Ca-pantothenate, 18.8 mg; niacin, 50 mg; biotin, 0.06 mg; folic acid, 1.25 mg; and vitamin B_{12}, 0.05 mg.

[b] Mineral premix supplied per kilogram of diet: Cu, 6 mg; Fe, 50 mg; Mn, 40 mg; Zn, 60 mg; Se, 0.075 mg.

II. 測定項目及方法

(i) 生長性狀：雞隻於第 3 週及第 6 週個別秤重並記錄各欄之飼料飼料採食量，計算 0 － 3 及 4 － 6 週齡體重、採食量及飼料效率如表 2，以瞭解抗生素的添加對生長性能之影響。

表 2.　飼糧中添加抗生素對肉雞生長性能之影響

Table 2.　Effect of antibiotic addition in the diet on the performance of broilers

Week	Control	OTC	Bacitracin	Nosiheptide
	---------- Body weight, g/bird ----------			
0	40.5 ± 1.83	40.6 ± 2.16	40.9 ± 2.43	40.8 ± 2.38
3	848 ± 118^{c}	863 ± 83.3^{c}	924 ± 67.9^{b}	960 ± 83.1^{a}
6	1,993 ± 255^{c}	2,124 ± 271^{b}	2,368 ± 276^{a}	2,285 ± 187^{a}
	Feed intake, g/bird			
0 － 3	1,032 ± 77.6^{b}	1,095 ± 71.3^{ab}	1,107 ± 45.3^{ab}	1,176 ± 65.9^{a}
4 － 6	2,756 ± 93.2	2,901 ± 305	3,063 ± 285	2,773 ± 191
0 － 6	3,788 ± 150	3,997 ± 331	4,170 ± 308	3,949 ± 200
	Feed/gain, g/g			
0 － 3	1.28 ± 0.05	1.34 ± 0.15	1.25 ± 0.04	1.28 ± 0.09
4 － 6	2.45 ± 0.31	2.33 ± 0.30	2.12 ± 0.09	2.10 ± 0.08
0 － 6	1.96 ± 0.18	1.93 ± 0.20	1.79 ± 0.08	1.76 ± 0.04

Means ± standard error.

$^{a, b, c}$ Means in the same row with different superscripts are significantly different ($P < 0.05$).

Control: basal diets without antibiotic addition, OTC: oxytetracycline.

(ii) 腸道組織形態學變化：將近端空腸和遠端迴腸用 pH 7.2 的 0.1 M 磷酸鹽緩衝鹽水 (PBS) 沖洗，然後用 10% 中性甲醛固定。24 小時後，從固定液中取出樣品，切成 1 cm^2 放入包埋夾中，以石蠟包埋，切片厚度為 6 μm。利用蘇木紫＆伊紅 (hematoxylin and eosin staining, H ＆ E stain) 將腸道切片染色後，依據 Yu and Chiou (1997) 方法，利用顯微鏡及 Image-Pro Express Version 6.0 (Media Cybernetics, USA) 軟體測量絨毛高度 (villus height)、腺窩深度 (the depth of crypt)、絨毛面積 (villus area) 及黏膜肌層厚度 (muscularis mucosa thickness)，並計算腺窩深度與絨毛高度的比值。腺窩深度相對絨毛高度以一根完整的絨毛及其相連的腺窩為一個單位計算；面積測量以一完整具有腸道上皮細胞之絨毛進行量測；黏膜肌層為垂直之最短距離。平均一隻雞隻切片每種型態測定 20 次。

(iii) 小腸雙醣酶活性分析：雞隻犧牲後刮取空腸與迴腸之黏膜經秤重後，參考 Hung *et al.* (2020) 方法進行分析。加入 10 倍樣品體積含 2.5 mM EDTA 磷酸鹽緩衝液稀釋後，均質 3 次，每次 10 秒，再使用超音波破膜機打破細胞，之後於 4℃以 14,000 rpm 離心 5 分鐘，取上清液為粗酵素液，取 100 μL 上清液適當倍數稀釋，再分別加入 0.28 mM 麥芽糖 (maltose) 100 μL 及 0.29 mM 蔗糖 (sucrose) 100 μL，於 37℃震盪作用 30 分鐘後，置入 100℃熱水 2 分鐘，終止酵素作用。每管加入 TGO 呈色劑 3 mL (0.1 M tris buffer, 0.3% 50 KU glucose oxidase type 5, 0.5% 50 KU peroxidase, 1% triton X-100, 0.032 mM o-dianisidine) (Sigma, USA)，震盪作用 1 小時，於 405 nm 波長測量其吸光值，粗酵素液使用 Bradford 檢測試劑盒 (Bio-Rad, Hercules, CA, USA) 測量蛋白質濃度。一個單位 (U) 的雙醣酶活性定義為在標準測定條件下每小時釋放 1 μmol 葡萄糖。雙醣酶以比活性 (specific activity) 表示每 1 mg 的蛋白質含有多少 unit 的雙醣酶酵素活性 (U/mg protein)。

(iv) 統計分析：實驗所獲得之資料使用 SAS 統計分析軟體 (SAS Institute, 2003)，以一般線性模式 (General Linear Model Procedure, GLM) 進行變方分析，如達顯著差異時再以鄧肯氏新多變域測定法 (Duncan's new multiple range test)，進行平均值比較，檢測組間差異之顯著性。資料皆以平均值 ± 標準偏差表示，本試驗顯著差異水準為 $P < 0.05$。

結果與討論

枯草菌素、六肽黴素及羥四環黴素具有不同的抗菌圖譜，可應用其治療疾病或促進生長作用來提高家畜禽業的

發展 (Diarra and Malouin, 2014)。本研究顯示，肉雞飼糧中添加枯草菌素和六肽黴素於 3 週及 6 週齡之體重及體增重皆顯著高於對照組 ($P < 0.05$)，而添加羥四環黴素組僅於 6 週齡時其體重及體增重亦顯著較對照組高 ($P < 0.05$)，枯草菌素和六肽黴素促進雞隻增重的效果於 6 週齡又顯著較羥四環黴素為高 ($P < 0.05$) (表 2)，添加枯草菌素和六肽黴素酸然降低了 4 － 6 週及 0 － 6 週飼料轉換率，提高飼料效率，但並未達顯著水準 ($P > 0.05$)。

動物飼糧中添加低劑量促進生長用的抗生素可增加體重 5 － 6%，提高飼料效率 3 － 4% (Zimmerman, 1986; CEAS, 1991; Butaye *et al.*, 2003)，施用枯草菌素和六肽黴素在提高體重增加和飼料效率與其結果相似。Weldon (1997) 指出生長促進與氮代謝的改善有關，包括表面氮消化率、氮保留和補充抗生素的豬的氮排泄減少。Oliver *et al.* (2014) 研究顯示抗生素添加在豬體內增加蛋白質含量並減少了脂質的蓄積。使用抗生素的動物之肉品品質量也更好，蛋白質含量增加，脂肪含量減少 (Hughes and Heritage, 2002)。這可能顯示添加飼糧中添加抗生素對促進生長的有益作用可能歸因於蛋白質蓄積增加。

腸道形態可評估腸道完整性和營養吸收效率。添加枯草菌素於 6 週齡時，相較於對照組顯著增加迴腸絨毛高度、空腸及迴腸絨毛長度與腺窩之比例 ($P < 0.05$)；添加六肽黴素於 3 週齡減少迴腸黏膜肌層厚度及 6 週齡空腸腺窩深度與絨毛長度與腺窩之比例 ($P < 0.05$)；添加羥四環黴素則顯著提高 3 週齡時空腸腺窩深度及黏膜肌層厚度 ($P < 0.05$) (表 3 及表 4)。

表 3. 飼糧中添加抗生素對肉雞空腸絨毛組織形態之影響

Table 3. Effect of antibiotics addition in the diet on villus histology of jejunum in broilers

Week/Item	Control	OTC	Bacitracin	Nosiheptide
3-wk-age				
Villus height, μm	866 ± 217	1,016 ± 132	972 ± 150	926 ± 139
Villus area, μm^2	169,175 ± 84,854	208,253 ± 67,386	183,274 ± 43,909	184,230 ± 43,820
Muscularis mucosae thickness, μm	36.8 ± 3.7^{b}	42.2 ± 6.0^{a}	35.6 ± 3.4^{b}	34.6 ± 2.9^{b}
Depth of crypt, μm	123 ± 20^{b}	151 ± 16^{a}	149 ± 20^{a}	120 ± 17^{b}
Ratio of villus/crypts cell	7.11 ± 1.63	6.81 ± 1.29	6.62 ± 1.34	7.71 ± 0.97
6-wk-age				
Villus height, μm	1,022 ± 198	1,083 ± 202	1,185 ± 108	1,058 ± 2079
Villus area, μm^2	218,102 ± 53,965	234,076 ± 45,326	236,941 ± 29,830	200,566 ± 62,283
Muscularis mucosae thickness, μm	48.2 ± 5.4	46.6 ± 5.2	46.7 ± 5.7	46.2 ± 3.1
Depth of crypt, μm	221 ± 16^{a}	215 ± 23^{a}	208 ± 16^{ab}	189 ± 20^{b}
Ratio of villus/crypts cell	4.67 ± 1.04^{b}	5.01 ± 0.52^{ab}	5.73 ± 0.75^{a}	5.66 ± 1.28^{a}

Means ± standard error.

$^{a, b}$ Means in the same row with different superscripts are significantly different ($P < 0.05$).

Control: basal diets without antibiotic addition, OTC: oxytetracycline (n = 20).

腸道上皮的表面積是營養吸收效率的重要指標。腺窩深度的減少顯示腸上皮細胞周轉 (turnover) 速度降低，意味著代謝成本降低 (Willing and Kessel, 2007; Long *et al.*, 2016)。研究指出，用大腸桿菌 K88 感染雞隻，雞隻空腸中的腺窩深度增加，而飼料中添加抗生素可利斯汀 (colistin) 則逆轉了這種負面影響 (Zhang *et al.*, 2016)。補充抗生素可利斯汀可以減少腸道粘膜的腺窩深度，並增加肉雞和豬十二指腸的絨毛高度 (Torrallardona *et al.*, 2003; Zhang *et al.*, 2016)。Hung *et al.* (2020) 指出添加可利斯汀和泰黴素 (tylosin) 增加絨毛面積及降低了空腸腺窩深度，推測添加抗生素可降低腸上皮細胞的代謝及增加絨毛營養吸收，有益於雞隻生長促進作用。本研究顯示枯草菌素增強了迴腸絨毛的高度及絨毛高度與腺窩深度之比例，而六肽黴素則降低 6 週齡雞隻空腸腺窩深度。這些變化顯示補充枯草菌素和六肽黴素可減少腸上皮細胞的周轉速度或增加絨毛吸收面積，進而促進生長。

腸道粘膜厚度與營養物質的利用、絨毛、線窩及黏膜肌層厚度有關 (Niewold, 2007)。在豬隻的研究顯示，較薄的腸道減少了能量消耗，因為器官重量增加對豬隻能量消耗的貢獻更大 (Pond *et al.*, 1988)。六肽黴素減少腸道粘膜厚度，這可能有利於營養吸收和減少能量消耗。相反的，羥四環黴素增加腸道黏膜厚度及空腸腺窩深度，顯示養分吸收效率降低，造成促進生長的效果較其他 2 種抗生素低。Percy and Christensen (1985) 研究顯示克林黴素 (clindamycin)、氨苄青黴素 (ampicillin) 和林可黴素 (lincomycin) 影響腸道粘膜肌層的張力和收縮，相對於本研究，六肽黴素的添加減少腸道粘膜厚度，可能與腸道肌肉的收縮有關。此外，前人研究顯示，餵飼乃卡巴精 (nicarbazin) 和沙利黴素 (salinomycin) 的家禽的盲腸固有層厚度減少，是盲腸病原體感染減少的間接指標 (Silva *et al.*, 2009)。添加氨基泰黴素 (tilmicosin) 減少腸道菌群並調節細胞因子 (cytokines)，而具有抗發炎作用 (anti-inflammatory) (Cao *et*

al., 2006)。相似的結果發現於可利斯汀和泰黴素添加降低了斷奶仔豬腸中的大腸桿菌和腸球菌含量，表明較低的細菌載量可以減輕免疫系統的壓力 (Torrallardona *et al.*, 2003; Cornick, 2010)。腸道壁厚度的增加與炎症進展過程中各種炎症細胞的水腫和浸潤的存在有關 (Larsson *et al.*, 2006)。可利斯汀和泰黴素可通過減少炎症細胞因子的反應來減輕炎症 (Cao *et al.*, 2006; Matzneller *et al.*, 2017)，而與本試驗研究羥四環黴素同類型之氯四環黴素 (Chlortetracycline, CTC) 並不能減少炎症細胞的增殖 (Tong *et al.*, 2002)，顯示不同抗生素對腸道粘膜厚度影響不同，可能由於抗生素對於炎症細胞的流入和累積反應不同所致。

表 4.　飼糧中添加抗生素對肉雞迴腸絨毛組織形態之影響

Table 4.　Effect of addition in the diet on villus histology in the ileum of broilers

Week/Item	Control	OTC	Bacitracin	Nosiheptide
3-wk-age				
Villus height, μm	555 ± 54.6	587 ± 129	572 ± 105	487 ± 44.5
Villus area, μm^2	82,643 ± 14,100^{ab}	88,593 ± 14,317^{ab}	92,394 ± 19,446^{a}	74,764 ± 13,164^{b}
Muscularis mucosae thickness, μm	45.7 ± 3.3^{a}	45.5 ± 6.2^{a}	48.8 ± 6.1^{a}	37.5 ± 2.6^{b}
Depth of crypt, μm	133 ± 33^{b}	135 ± 31^{b}	165 ± 24^{a}	108 ± 9^{b}
Ratio of villus/crypts cell	4.36 ± 1.00^{a}	4.43 ± 1.03^{a}	3.51 ± 0.75^{b}	4.54 ± 0.26^{a}
6-wk-age				
Villus height, μm	612 ± 62.5^{b}	613 ± 88.6^{b}	733 ± 102^{a}	577 ± 60.1^{b}
Villus area, μm^2	120,756 ± 16,845	121,003 ± 20,949	136,308 ± 22,616	116,182 ± 26,080
Muscularis mucosae thickness, μm	52.9 ± 5.2	52.3 ± 4.6	53.0 ± 7.1	50.8 ± 4.7
Depth of crypt, μm	161 ± 33	180 ± 32	162 ± 30	179 ± 17
Ratio of villus/crypts cell	3.98 ± 1.12^{b}	3.46 ± 0.47^{b}	4.70 ± 1.23^{a}	3.26 ± 0.53^{b}

Means ± standard error.

$^{a, b}$ Means in the same row with different superscripts are significantly different ($P < 0.05$).

Control: basal diets without antibiotic addition, OTC: oxytetracycline (n = 20).

腸道中的消化酶活性在營養物質的消化中扮演著重要的角色。雞隻飼料中的玉米澱粉成分高，若雙醣酶的活性越高，將碳水化合物水解為葡萄糖以利吸收的能力也會隨之增加 (Scott *et al.*, 2004)。抗生素具有調節消化酶活性的能力，純黴素和六肽黴素的補充除了改善雞的生長性能外，還增加了雞隻腸道麥芽糖酶和蔗糖酶的腸道活性 (Al-Batshan *et al.*, 1992; Lee *et al.*, 2011)。補充可利斯汀可以增強空腸中麥芽糖酶和蔗糖酶的活性，進一步提高斷奶豬腸道的養分利用率 (Wan *et al.*, 2016)。用大腸桿菌 K88 攻擊的雞顯示腸屏障功能降低，澱粉酶、蛋白酶及脂肪酶的活性亦降低，補充可利斯汀可改善這些負面影響 (Zhang *et al.*, 2016)。本實驗結果顯示，飼糧中添加枯草菌素及六肽黴素有減少 3 週齡雞隻腸道雙醣酶的活性之趨勢 ($P < 0.1$) (圖 1 及 2)，進而提高動物腸道營養消化。

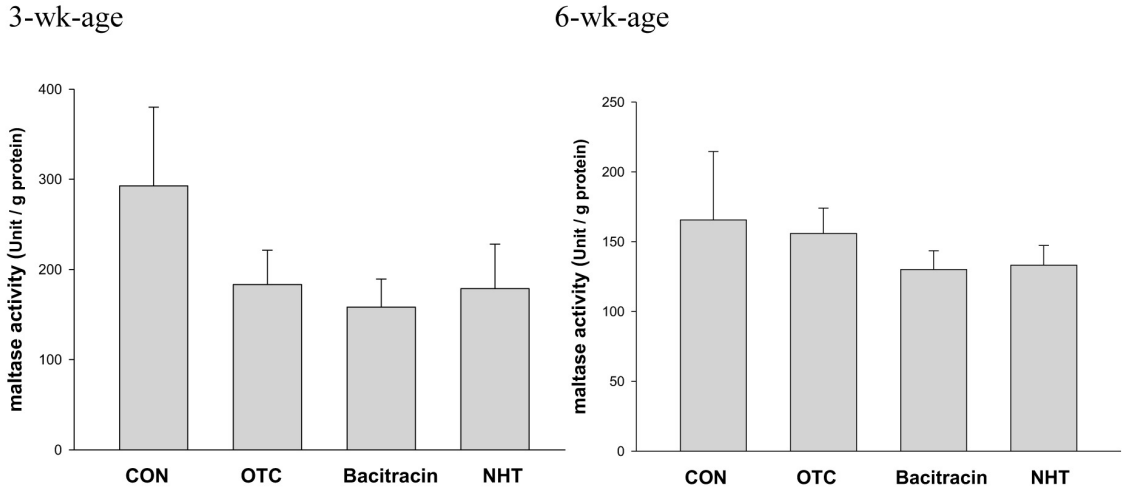

圖 1.　飼糧中添加抗生素對 3 及 6 週齡之肉雞空腸黏膜麥芽糖酶活性影響。

Fig. 1.　Maltase activites in jejunum of 3-wk and 6-wk-age broilers fed different antibiotics. One unit of maltase activity was defined as 1 μmol glucose released per hour under standard assay conditions.
CON:control, OTC: oxytetracycline, NHT: nosiheptide.

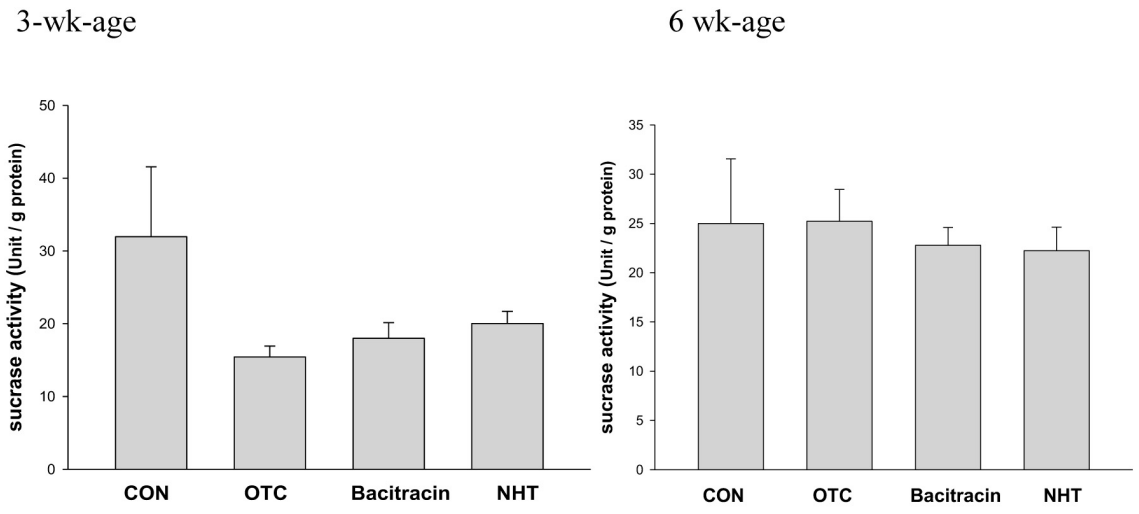

圖 2. 飼糧中添加抗生素對 3 及 6 週齡之肉雞空腸黏膜蔗糖酶活性影響。

Fig. 2. Sucrase activities in jejunum of 3-wk and 6-wk-age old broilers fed different antibiotics. One unit of sucrase activity was defined as 1 μmol glucose released per hour under standard assay conditions.
CON:control, OTC: oxytetracycline, NHT: nosiheptide.

結　論

飼糧中添加枯草菌素及六肽黴素能夠透過改變腸道形態來加速肉雞的生長，而不同抗生素可能對於腸道的形態影響也不同，枯草菌素及六肽黴素透過調節腸道形態來促進其生長之表現。

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Effects of antibiotics addition on intestinal morphology and disaccharidase activity in broilers [1]

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Abstract

The study emphasizes on the potential effects of antibiotics on intestinal digestion and integrity in broilers with respect to histological morphology and disaccharidase activity. A total of 192 one-day-old Arbor Acres birds were randomly allocated to one of the following four treatments for 42 days including control, bacitracin (55 mg/kg), nosiheptide (2.5 mg/kg), and oxytetracycline (OTC, 55 mg/kg) groups. The addition of bacitracin and nosiheptide caused an increase in body weight gain at 3 wk and 6 wk of age and OTC addition only promoted weight gain at 3 wk of age ($P < 0.05$). The addition of bacitracin and nosiheptide had a marginal effect on disaccharidase activity in the jejunum and ileum at 3 wk of age ($P < 0.1$). The addition of bacitracin significantly increased the villus area length of ileum, and the ratio of villus to crypt cell of jejunum and ileum at 6 wk of age when compared with the control group ($P < 0.05$). The addition of nosiheptide reduced the thickness of the ileum mucosae at 3 wk of age and decreased the depth of crypt in the jejunum at 6 wk of age ($P < 0.05$). On contrary, CTC thickened the muscularis mucosae and the depth of crypt in the jejunum at 3 wk of age ($P < 0.05$). In sum, bacitracin and nosiheptide exhibit a beneficial effect on intestinal integrity by improving gut morphology.

Key words: Broilers, Antibiotics, Disaccharidase activities, Intestinal morphology.

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