# 高油分玉米對北京鴨生長性能與屠體性狀之影響(1)

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## 摘 要

本試驗之目的在評估高油分玉米(high oil corn, HOC)餵飼北京鴨之生產效果，試驗分三處理組，每處理組3 重複，每重複24隻，公母各半，重複兩批餵飼試驗。各處理組飼糧之熱能及粗蛋白質近似，處理一飼糧以傳統玉米(CC)及大豆油為主要能量來源;處理二飼糧以 HOC 取代處理一之 CC 及大豆油;處理三飼糧與處理二飼糧近似，唯其 HOC 用量與處理一之 CC 用量相同。試驗期間飼糧之代謝能為 2900 kcal/kg，0~3 及 3~10 週齡之粗蛋白質分別為 19% 及 16%。鴨隻於 0、3、6 及 10 週齡個別稱重，並記錄 0~3、3~6 及 6~10 週齡飼料採食量與飼料利用效率，試驗結束10週齡時，每重複各取公母兩隻屠宰，測定活體重、血液重、羽毛重、屠體重、腹脂重、腸重及可食內臟重，包括心、肝、砂囊。此外，並測定胸肉之一般組成分及貯存期間之脂質氧化安定性。

結果顯示:餵飼HOC組之鴨隻0~6週齡採食量略較餵飼CC組為低，6週齡體重亦較輕。然而在6~10週齡則呈現相反的趨勢，餵飼HOC組之鴨隻採食量略較餵飼CC組為高，且10週齡體重有較重的趨勢。在屠體性狀方面，餵飼HOC有降低腹脂重及胸肉之粗脂肪含量的趨勢，且砂囊重及肝臟重有增加的趨勢，屠宰率、羽毛重、血液重、心重及腸重則未受飼糧中玉米種類影響，HOC 亦未改進胸肉之脂質氧化安定性。由此可見，餵飼 HOC 有改善飼料效率及降低腹脂重與胸肉中粗脂肪含量的趨勢。

關鍵詞：高油分玉米、北京鴨、生長性能、屠體性狀、氧化安定性。

## 緒 言

1896 年美國伊利諾大學即開始選拔玉米中脂肪含量，至 1981 年已經歷 82 代，選拔後玉米中

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脂肪含量高達 19% ，商業雜交玉米品系的脂肪含量 6%~8%(Watson and Freeman, 1975)，高油分玉米(HOC)自商業生產上市後，其市場佔有率正逐年成長。HOC除可提高飼糧之能量、減少飼糧中油脂之添加量、舒緩熱緊迫、降低粉塵外，還可提高一些低營養濃度副產物之使用量及增加禽肉之油酸含量(Rand and Noy, 1997)。HOC使用於肉雞飼糧可改進體增重及飼料利用效率(Han *et al.*, 1987; Adams *et al.*, 1994; Mireles *et al.*, 1996)，並降低腹脂的重量及蒸煮失重(Adams *et al.*, 1994);HOC 亦改善臺灣土雞之飼料效率，同時降低砂囊佔空體重之百分比(林等， 1997);此外， HOC 使用於蛋雞飼糧亦有較佳之飼料換蛋率(Han *et al.*, 1987)。由於 HOC 之脂肪酸組成與傳統玉米(CC)不同，所以肉雞飼糧中含 HOC 亦改變肉雞屠體及脂肪組織之脂肪酸組成(Adams *et al.*, 1994; Mireles *et al.*, 1996; Rand and Roy, 1997)。 HOC 除脂肪酸含量較高外，其維生素 E 含量亦較 CC 為高，可增加肉雞屠體於貯存期間之脂質氧化安定性 (Araba and McNaughton, unpublished)。

高油分玉米有改善土番鴨之體增重及飼料利用效率的趨勢(潘， 1997)，由於北京鴨之生長曲線及體組成與土番鴨差異甚大，本試驗之目的在探討餵飼高油分玉米對北京鴨生長性能、屠體性狀、胸肉之一般組成分及貯存安定性的影響。

## 材料與方法

I. 試驗設計及飼糧調製

北京雛鴨共 432 隻，分兩批次飼養，每批次 216 隻，逢機分飼九欄，每處理組三欄，每欄 24 隻，公母各半。試驗分三處理組，處理一飼糧以 CC 及大豆油為主要能量來源；處理二飼糧以 HOC 取代處理一之 CC 及大豆油;處理三飼糧與處理二飼糧近似，唯其 HOC 用量與處理一之 CC 用量相同。此外，亦稍微調整其它飼料原料用量，俾使各處理組飼糧之代謝能及粗蛋白質含量近似。試驗期間飼糧之代謝能為 2900 kcal/kg， 0~3 及 3~10 週齡之粗蛋白質分別為 19% 及 16%(表 1 及表 2)。

II. 資料收集

鴨隻於 0 、 3 、 6 及 10 週齡個別稱重，並記錄 0~3 、 3~6 及 6~10 週齡飼料採食量與飼料效率，試驗結束10週齡時，每重複各取公母兩隻屠宰，測定活體重、血液重、羽毛重、屠體重、腹脂重、腸重及可食內臟重，包括心臟、肝臟及砂囊。

III. 一般組成分分析

水分、灰分、粗蛋白質及粗脂肪含量依 A.O.A.C. (1984)之方法測定。

IV. 胸肉 TBA 值測定

鴨隻屠宰後取下胸肉，於 3℃冷藏，每 3 天進行氧化安定性測定至第 9 天。將胸肉細碎混勻後取兩重複，每重複試樣 10 g ，加蒸餾水 50 ml 均質後，加 47.5 ml 蒸餾水洗入 Kjeldahl 梨形瓶中，另加 4 N HCl 2.5 ml 及 5 滴消泡劑溶液(Antiforam A, Sigma)，經蒸餾收集至 50 ml ，取此蒸餾液 5 ml ，並加入 0.02 M TBA 試劑 5 ml 置於沸水浴中，加熱 35 分鐘後，用流水浴冷卻 10 分鐘，以 538 nm 測其吸光值(O. D.值)，並以 5 ml 蒸餾水做空白試驗（Tarladgis *et al.*, 1960）。

表 1. 試驗飼糧組成(0~3 週齡)

Table 1. The composition of the experimental diets (0~3 weeks of age)

| Item | Treatment | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| Corn, yellow | 58.60 | - | - |
| High oil corn | - | 62.00 | 58.60 |
| Soybean meal, 44% | 28.00 | 26.60 | 28.00 |
| Wheat bran | 6.00 | 6.00 | 4.50 |
| Rice hull | - | - | 3.50 |
| Soybean oil | 2.00 | - | - |
| Yeast | 2.50 | 2.50 | 2.50 |
| Limestone, pulverized | 0.75 | 0.75 | 0.75 |
| Dicalcium phosphate | 1.20 | 1.20 | 1.20 |
| Vitamin premix[a] | 0.30 | 0.30 | 0.30 |
| Mineral premix[b] | 0.20 | 0.20 | 0.20 |
| DL-Methionine | 0.05 | 0.04 | 0.04 |
| L-Lysine-HCl, 78% | 0.10 | 0.11 | 0.11 |
| Iodized salt | 0.30 | 0.30 | 0.30 |
| Total | 100.00 | 100.00 | 100.00 |
| Calculated value | | | |
| Crude protein, % | 18.79 | 18.76 | 18.86 |
| ME, kcal/kg | 2911 | 2924 | 2904 |
| Calcium, % | 0.72 | 0.70 | 0.69 |
| Avail. Phosphorus, % | 0.42 | 0.42 | 0.42 |
| Analyzed value | | | |
| Crude protein, % | 18.57 | 18.09 | 18.55 |
| Calcium, % | 0.66 | 0.67 | 0.64 |
| Total phosphorus, % | 0.57 | 0.60 | 0.58 |

[a] Vitamins supplementation per kg of diet:

Vitamin A, 10,000 IU; Vitamin $D_3$, 1,000 IU; 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%), 1,500 mg.

[b] Minerals supplementation per kg of diet:

Mn, 60 mg ($MnSO_4 \cdot H_2O$); Zn, 60 mg (ZnO); Cu, 5 mg ($Cu_2SO_4 \cdot 5H_2O$); Se, 0.1 mg ($Na_2SeO_3$).

V. 統計分析

體重及屠體各分切部位是以單一鴨隻的體重求平均，體增重、飼料採食量及飼料效率則以每一欄的資料求平均，試驗資料以ANOVA分析其整體差異性，再以Duncan's多變域分析處理組間之差異顯著性(SAS, 1988)。

表 2. 試驗飼糧組成 (3～10 週齡)

Table 2. The composition of the experimental diets (3～10 weeks of age)

| Item | Treatment | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| Corn, yellow | 65.00 | - | - |
| High oil corn | - | 66.00 | 65.00 |
| Soybean meal, 44% | 20.00 | 19.00 | 19.00 |
| Wheat bran | 9.00 | 9.00 | 9.60 |
| Rice hull | - | 1.10 | 1.50 |
| Soybean oil | 1.10 | - | - |
| Yeast | 2.00 | 2.00 | 2.00 |
| Limestone, pulverized | 0.80 | 0.80 | 0.80 |
| Dicalcium phosphate | 1.20 | 1.20 | 1.20 |
| Vitamin premix[a] | 0.30 | 0.30 | 0.30 |
| Mineral premix[b] | 0.20 | 0.20 | 0.20 |
| DL-Methionine | 0.04 | 0.04 | 0.04 |
| L-Lysine-HCl, 78% | 0.06 | 0.06 | 0.06 |
| Iodized salt | 0.30 | 0.30 | 0.30 |
| Total | 100.00 | 100.00 | 100.00 |
| Calculated value | | | |
| Crude protein, % | 16.05 | 16.05 | 16.05 |
| ME, kcal/kg | 2896 | 2923 | 2896 |
| Calcium, % | 0.73 | 0.72 | 0.72 |
| Avail. phosphorus, % | 0.36 | 0.35 | 0.36 |
| Analyzed value | | | |
| Crude protein, % | 15.69 | 15.58 | 15.73 |
| Calcium, % | 0.76 | 0.74 | 0.71 |
| Total phosphorus, % | 0.64 | 0.64 | 0.65 |

[a] Vitamins supplementation per kg of diet:

Vitamin A, 10,000 IU; Vitamin $D_3$, 1,000 IU; 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%), 1,500 mg.

[b] Minerals supplementation per kg of diet:

Mn, 60 mg ($MnSO_4 \cdot H_2O$); Zn, 60 mg (ZnO); Cu, 5 mg ($Cu_2SO_4 \cdot 5H_2O$); Se, 0.1mg ($Na_2SeO_3$).

## 結果與討論

北京鴨三週齡體重及 0～3 週齡飼料效率在各組間無顯著差異(表 3)，然而第二組鴨隻 0～3 週齡飼料採食量低於第一組($P<0.05$)，第三組之飼料採食量亦略低於第一組($P>0.05$)。餵飼HOC組

(處理組二和三)鴨隻在0~6週齡之飼料採食量略較餵飼CC組為低，此可能是造成餵飼HOC組鴨隻之六週齡體重較輕的原因之一。雖然如此，餵飼HOC鴨隻是在十週齡體重有較重的趨勢，此應與6~10週齡飼料採食量較高且飼料效率較佳之趨勢有關(表3)，此現象印證鴨隻之補償性生長(Leeson and Summers, 1997)。由以上資料觀之，餵飼HOC確有改善飼料效率之趨勢，此可能與鴨隻對HOC能量利用率、脂肪消化率及胺基酸消化率有關(陳, 未發表資料; Araba *et al.*, 1998; Parsons *et al.*, 1998)，肉雞對HOC之氮矯正真代謝能/總能比率($TME_N$/GE)及真脂肪消化率(True oil digestibility)之數值較CC為高($P>0.05$)(Araba *et al.*, 1998)，而且肉雞對HOC胺基酸消化率也較CC為高(Parsons *et al.*, 1998)，土番鴨對HOC之必需胺基酸消化率亦略較CC為高(88.9 vs. 87.3%)(陳，未發表資料)。

在屠體性狀方面，餵飼HOC對屠宰率沒有顯著影響(表4)，此與肉雞之結果一致(Adams *et al.*, 1994; Mireles *et al.*, 1996)。然而飼糧含HOC有降低腹脂重之趨勢(表4)，此現象亦出現在肉雞之試驗(Han *et al.*, 1987; Adams *et al.*, 1994)，由於HOC有改變肉雞屠體及脂肪組織的脂肪酸組成之趨勢(Adams *et al.*, 1994; Mireles *et al.*, 1996; Mello *et al.*, 1997)，而且餵飼HOC組鴨隻之胸肉，其粗脂肪之含量有低於餵飼CC組鴨隻之趨勢，此粗脂肪之降低伴隨粗蛋白質之增加(表5)，雖然粗脂肪之標準偏差較預期大，但由於個別胸肉之一般組成分總和接近100% (97.1~101.2%)，此變異乃因各處理組內鴨隻之個別差異所引起，可見HOC確實造成北京鴨脂肪堆積及胸肉一般組成分之變化。餵飼HOC鴨隻之砂囊及肝臟有較重的趨勢(表4)，此與林等(1997)以土雞之試驗結果不同，除了屠宰週齡不同外，物種亦可能是造成此差異之原因。本試驗HOC造成北京鴨腹脂較輕及砂囊較重之現象，亦未出現在餵飼HOC之土番鴨試驗中(潘，1997)，可見不同鴨品種在餵飼HOC飼糧後，對屠體性狀之影響有所差異。砂囊之肌肉極為發達，其中之砂礫可磨碎食物而增加食物之消化率(季, 1984)，本試驗之砂囊及肝臟重量增加是否與10週齡體重有所關連(表3)，仍待進一步了解。另一方面，HOC組之砂囊重量增加，可能與飼糧中含稻殼粉有關，因為砂囊之生長受飼糧中纖維含量所影響(楊,1979)。屠體資料之羽毛重、血液重、心臟及腸重則

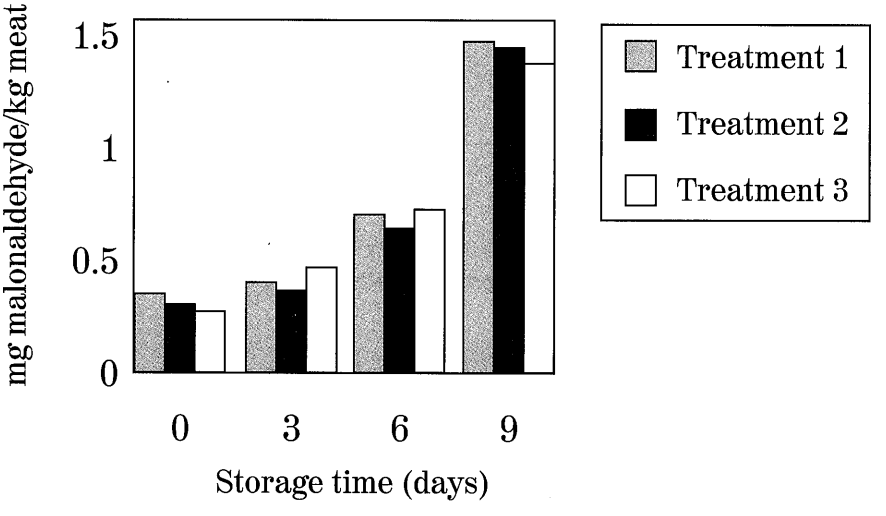


圖 1. 飼糧中高油分玉米對北京鴨胸肉於3℃貯存期間TBA值之影響。

Fig. 1. Effects of dietary high oil corn on the TBA values of breast meat of Peking ducks during storage at 3℃.

表 3. 含高油分玉米飼糧對北京鴨體重、增重、飼料採食量及飼料效率之影響[A]

Table 3. Effects of dietary high oil corn on body weight, body weight gain, feed intake and feed efficiency in Peking ducks[A]

| | Treatment[B] | | |
|---|---|---|---|
| Age (week) | 1 | 2 | 3 |
| | Body weight (g) (n=144) | | |
| 0 | 60 ± 5 | 61 ± 6 | 61 ± 6 |
| 3 | 925 ± 172 | 898 ± 180 | 906 ± 190 |
| 6 | 2612 ± 308[a] | 2537 ± 274[b] | 2585 ± 297[ab] |
| 10 | 3629 ± 400 | 3671 ± 361 | 3699 ± 394 |
| | Body weight gain (g) (n=6) | | |
| 0~3 | 865 ± 44 | 837 ± 56 | 845 ± 88 |
| 3~6 | 1687 ± 45 | 1641 ± 76 | 1679 ± 59 |
| 6~10 | 1017 ± 159 | 1132 ± 114 | 1115 ± 98 |
| 0~10 | 3569 ± 179 | 3610 ± 79 | 3638 ± 173 |
| | Feed intake (g/bird/day)(n=6) | | |
| 0~3 | 79 ± 2[a] | 73 ± 4[b] | 76 ± 4[ab] |
| 3~6 | 222 ± 8 | 215 ± 7 | 218 ± 7 |
| 6~10 | 210 ± 44 | 219 ± 40 | 215 ± 48 |
| 0~10 | 174 ± 15 | 174 ± 14 | 174 ± 21 |
| | Feed efficiency(n=6) | | |
| 0~3 | 1.92± 0.08 | 1.83± 0.08 | 1.89± 0.09 |
| 3~6 | 2.76± 0.10 | 2.75± 0.15 | 2.73± 0.13 |
| 6~10 | 5.76± 0.59 | 5.43± 0.99 | 5.37± 1. 07 |
| 0~10 | 3.41± 0.18 | 3.37± 0.25 | 3.34± 0.29 |

[A] Data were compiled from two feeding trials. There were three replicates per treatment in each feeding trial. Each replicate provided one data for body weight gain, feed intake and feed efficiency. Data refer to mean ± SD.

[B] An isocaloric and isonitrogenous ration with yellow corn was used in treatment 1, while high oil corn was used in treatment 2. High oil corn, with its amount the same as yellow corn used in treatment 1, was also used in treatment 3.

[ab] Data within the same row with different superscripts are significantly different ($P<0.05$).

各處理間無顯著差異。

HOC 中含維生素 E 之含量較 CC 高出約 60~70%(Araba, 1997)，Araba and McNaughton 之研究顯示飼糧中含HOC可增加雞肉貯存期間之脂質氧化安定性(未發表資料)，然而本試驗並未發現此改善效果(圖 1)。胡(1995)以維生素E添加於土番鴨飼糧中，其維生素E含量為對照組飼糧之 5 倍，在上市(10 週齡)前經添加維生素 E 10~70 天後發現，其胸肉在 4℃貯存期間之脂肪氧化安定性有改善的趨勢。造成上述結果差異之原因，可能是試驗動物胸肉粗脂肪含量及脂肪酸組成不

表 4. 餵飼高油分玉米對 10 週齡北京鴨屠體性狀之影響[A]

Table 4. Effects of dietary high oil corn on the carcass traits of Peking ducks at 10 weeks of age[A]

| | Treatment[B] | | |
|---|---|---|---|
| Carcass trait | 1 | 2 | 3 |
| Dressing percentage (%) | 75.5 ± 4.7 | 76.1 ± 1.7 | 75.5 ± 2.1 |
| Abdominal fat weight (g) | 48.6 ± 15.7 | 40.3 ± 13.3 | 44.6 ± 13.3 |
| Relative abdominal fat weight (%) | 1.4 ± 0.4[a] | 1.1 ± 0.3[b] | 1.2 ± 0.3[ab] |
| Liver weight (g) | 69.6 ± 12.6[a] | 80.1 ± 19.8[b] | 78.1 ± 15.0[ab] |
| Relative liver weight (%) | 1.9 ± 0.3[a] | 2.2 ± 0.4[b] | 2.1 ± 0.3[ab] |
| Gizzard weight (g) | 110.2 ± 19.4[a] | 120.6 ± 21.7[ab] | 124.6 ± 26.0[b] |
| Relative gizzard weight (%) | 3.1 ± 0.4[a] | 3.3 ± 0.6[ab] | 3.4 ± 0.6[b] |

[A] Data were compiled from two feeding trials. There were three replicates per treatment in each feeding trial. Two males and two females were slaughtered in each replicate. n=24. Data refer to mean ± SD.

[B] as indicated in Table 3.

[ab] Data within the same row with different superscripts are significantly different ($P<0.05$).

表 5. 餵飼高油分玉米對 10 週齡北京鴨胸肉一般組成分之影響[A]

Table 5. Effects of dietary high oil corn on the approximate composition of breast meat in Peking ducks at 10 weeks of age[A]

| | Treatment[B] | | |
|---|---|---|---|
| Approximate composition | 1 | 2 | 3 |
| Moisture (%) | 68.63± 3.49 | 68.01± 2.95 | 68.66± 1.10 |
| Ash (%) | 1.24± 0.07 | 1.17± 0.08 | 1.18± 0.10 |
| Crude protein (%) | 25.00± 4.06 | 26.88± 1.84 | 26.38± 1.71 |
| Crude fat (%) | 4.42± 1.23 | 3.10± 1.04 | 2.95± 1.49 |

[A] Data were only obtained from the second feeding trial. There were three replicates per treatment. Breast meats from one male and one female were analyzed in each replicate. n=12. Data refer to mean ± SD.

[B] as indicated in Table 3.

同所致。北京鴨、土番鴨及肉雞之胸肉粗脂肪含量分別為 5.9~6.4 、1.0~2.1 及 0.5%(張， 1985; 王， 1995; Scott and Dean, 1991; Baeza, 1999)，且鴨肉中之不飽和脂肪酸較雞為高(Baeza, 1999)，可能抵消HOC高出之維生素E的抗氧化效果所致。因此，雖然HOC含有較高量的維生素E，其含量仍未足以改善北京鴨胸肉於貯存期間之脂肪氧化安定性。北京鴨胸肉於3℃貯存期間，TBA值從第0天之0.2~0.3增加至第6天之0.6~0.7，至第9天其TBA值更達1.3~1.4 (圖1)，高於一般認定之酸敗標準值1.0。

由此可見，餵飼HOC有改進北京鴨飼料效率之趨勢，除增加肝臟及砂囊重外，亦有降低腹脂重及胸肉脂肪含量之趨勢，然而對胸肉儲存期間之氧化安定性並無改善效果。

## 誌　謝

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# Effects of Feeding High Oil Corn on Growth Performance and Carcass Traits in Pekin Ducks (1)

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**Abstract**

The objectives of this study were to evaluate the effects of high oil corn (HOC) on the growth performance and carcass characteristics in Peking ducks. Isocaloric and isonitrogenous diets were used. Metabolizable energy (ME) was 2900 kcal/kg of diet throughout this study. The levels of crude proteins (CP) were 19% and 16% for the starter and finisher diet, respectively. Body weight, body weight gain, feed intake and feed efficiency were recorded. At 10 weeks of age, two males and two females from each replicate were slaughtered. Live weights, bleeding weights, plucking weights, and weights of carcass, abdominal fat, intestine, liver, heart, and gizzard were determined. Approximate composition and oxidative stability of breast meat were also investigated.

Body weights at 3 weeks of age were similar among groups. Although there was a trend of lower feed intake in the treatments with HOC between 0 and 6 weeks of age, feed efficiency was similar among treatments at this period. A lower body weight at 6 weeks of age was observed in the ducks fed diets with HOC. However, at 10 weeks of age, Peking ducks fed diets with HOC tended to have higher body weights and better feed efficiency than those ducks fed diets with CC. When slaughtered at 10 weeks of age, Peking ducks fed diets with HOC tended to decrease relative abdominal fat weights and crude fat in the breast meat. However, a trend of higher gizzard and liver weights was noted in ducks fed diets with HOC. In conclusion, Peking ducks fed diets contain-

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ing HOC tended to improve feed efficiency, less abdominal fat, and lower proportion of crude fat compared to ducks fed diets with CC.

Key words: High oil corn, Peking duck, Growth performance, Carcass trait, Oxidative stability.