

# 闖公雞、復陽雞及公雞之屠體及 肌肉物理性狀比較<sup>(1)</sup>

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## 摘 要

本試驗旨在比較闖公雞、復陽雞及公雞間之屠宰率、屠體部位與器官比例及肌肉物理性狀之差異。試驗選用畜試土雞台畜肉十三號公雞，雞隻於 10 週齡去勢，並餵給生長期飼料 (10 – 18 週齡) 及肥育期飼料 (19 – 28 週齡)。於 28 週齡時再將闖公雞處理組，依雞冠有無再度發育，分為闖公雞組與復陽雞組。雞隻經 24 小時禁食後，進行個別雞隻秤重，每處理組逢機犧牲 16 隻。試驗結果顯示，屠宰率、腹脂、心臟、腿部、背部及胸部比例，於三者間呈顯著 ( $P < 0.05$ ) 差異。屠宰率、心臟及腿部比例以公雞為最高，闖公雞為最低，而腹脂、背部及胸部比例，以闖公雞為最高，公雞為最低。闖公雞之頭頸比例顯著 ( $P < 0.05$ ) 較復陽雞或公雞為低。翅膀及腸道比例，則以闖公雞顯著 ( $P < 0.05$ ) 較復陽雞或公雞為高。闖公雞之脾臟比例顯著 ( $P < 0.05$ ) 較復陽雞為低。公雞之腳部比例顯著 ( $P < 0.05$ ) 較闖公雞為高。胸寬、砂囊及肝臟比例於三者間無顯著差異。闖公雞之肌纖維直徑及面積顯著 ( $P < 0.05$ ) 較公雞為細且小。闖公雞肌肉之韌度顯著 ( $P < 0.05$ ) 低於公雞，但肌肉之咀嚼性及彈力於三者間無顯著差異。綜合本試驗之結果顯示，雞隻去勢會影響屠宰率、屠體部位與器官比例及肌肉物理性狀。復陽雞各性狀之表現則介於闖公雞或公雞間。

關鍵詞：去勢、復陽雞、屠體性狀、肌肉物理性狀、臺灣土雞。

## 緒 言

有關闖公雞之生產技術，在中外書籍中被記載已超過 2000 年 (鄒, 1995; Stromberg, 1980; Winter and Funk, 1960)。公雞去勢會改變性成熟過程及生產性狀，如行為、第二性徵、體溫、血液生理值與血清生化值、飼料採食量、增重速度、屠宰率、屠體部位與器官比例、肌肉化學組成與 ATP 關聯化合物含量、肌纖維直徑與面積、肌肉截切值與韌度等物理性狀及骨骼性狀等已有文獻報導 (林, 1999; 林及徐, 2011a, b; Lin and Hsu, 2002, 2003a, b; Lin *et al.*, 2011, 2012)。闖公雞肥育完成，其肌肉之風味、嫩度及多汁性較未去勢公雞佳 (York and Mitchell, 1969; USDA, 1977; Mast *et al.*, 1981)。雞隻於去勢 8 – 10 週後，闖公雞之體重即可超越未去勢公雞 (Welter, 1976; Mast *et al.*, 1981)。如去勢至上市週齡低於 8 週則闖公雞之體重低於未去勢公雞 (York and Mitchell, 1969; Cason *et al.*, 1988)。闖公雞於早期生長受到抑制，主要是因外科去勢手術緊迫所造成 (Cason *et al.*, 1988)。雄性素在雞隻可抑制生長及脂肪之蓄積 (Deyhim *et al.*, 1992; Fennell and Scanes, 1992a; Fennell *et al.*, 1996)。Mast *et al.* (1981) 指稱，部分去勢雞隻之增重及飼料利用效率較完全去勢及未去勢公雞佳，肌肉嫩度則介於二者之間。睪固酮可改變肌纖維之型態及促進肌纖維之發育 (Venable, 1966; Muller *et al.*, 1969; Bass *et al.*, 1971)，而肌纖維型態及大小會影響雞肉組成及韌度 (Benjamin *et al.*, 1949; Tuma *et al.*, 1962; Herring *et al.*, 1965; Asmore, 1974; Judge *et al.*, 1988)。在牛、豬、羊等雄性家畜，去勢會改變屠體部位間之比例 (Field, 1971; Seideman *et al.*, 1982)。闖雞一向為我國傳統之

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產業，閩雞肉普遍為國人所喜愛；在臺灣閩雞之飼養，均採用有色雞種（土雞或鬥雞）進行生產，與國外明顯不同，有市場區隔之效果，故閩雞之相關生產技術值得研究探討。但復陽雞（slip；去勢不確實）之屠體性狀與肌肉之物理性狀與公雞及閩公雞之差異性有多大，之相關報告甚少。復陽雞是因去勢操作時睪丸在腹腔中破碎或與腹腔連結處之睪丸組織未能完全取出，使殘留於腹腔之睪丸再發育生長，或破裂之睪丸組織附著於腹腔中再度發育生長，並可分泌雄性素（Lin and Hsu, 2003a）。此為去勢操作不慎所造成，與去勢操作時僅取出單一側睪丸之部分去勢不同。其在閩雞群之發生比例會因閩雞師傅之技術熟練度及去勢雞隻週齡而有差異，約介於 15 至 60% 間（林，2003）。復陽雞之羽毛外觀與閩公雞相同，然而雞冠紅色度及大小較閩公雞為紅且大，因此可由外觀區分出復陽雞及閩公雞（雞冠萎縮且有鱗屑）。復陽雞之活體售價每台斤比閩公雞之價格低約 8 至 12 元。因此，本試驗旨在探討閩公雞、復陽雞及公雞間之屠宰率、屠體部位與器官比例及肌肉物理性質之差異，以供業者之參考。

## 材料與方法

### I. 試驗動物與試驗設計

本試驗於行政院農業委員會畜產試驗所執行。動物之使用、飼養及實驗內容係依據畜產試驗所實驗動物管理委員會核准之試驗準則進行。試驗採用行政院農業委員會畜產試驗所育成之畜試土雞台畜肉 13 號公雞。於 10 週齡時將公雞逢機分為去勢處理組與未去勢處理組。每處理組 88 隻分置於四欄，每欄飼養 22 隻，共計 176 隻試驗動物。試驗處理期間為 10 – 28 週齡。於 28 週齡時再將去勢處理組，依雞冠有無再度發育（大小、顏色及鱗屑狀）分為閩公雞組與復陽雞組，其中閩公雞 43 隻，復陽雞 41 隻，復陽雞比例為 48.8%。

### II. 試驗動物之飼養管理

公雞於 10 週齡去勢，去勢前禁食 24 小時，水照常給飼，去勢後於 10 – 18 週齡間，餵給蛋白質 19%，代謝能 3,000 kcal/kg 之生長期飼料，於 19 – 28 週齡間，餵給蛋白質 17%，代謝能 2,800 kcal/kg 之肥育期飼料。雞隻依一般飼養管理方法飼養。試驗期間水與飼料採任食，給予 23 小時光照，至 28 週齡止。於 28 週齡時雞隻經 24 小時禁食後，進行個別雞隻秤重。每處理組逢機屠宰 16 隻（每處理組每欄屠宰 4 隻），於實驗室進行屠體性狀調查，屠宰雞隻經 CO<sub>2</sub> 迷昏、放血、脫毛、取下腹脂及取出內臟後，進行屠體重測定，屠體分切依 Koch and Possa (1973) 之方法進行頭頸、翅（三節翅）、胸（帶骨帶皮）、背、腿（清腿，帶骨帶皮）及腳六大部位分切，並取下左右兩側胸肉及腿肉（去骨、去皮）供測定肌肉物理性狀之用。

### III. 檢測項目與方法

#### (i) 外科去勢及復陽雞判斷

依 Lin and Hsu (2003a) 之方法進行去勢與區分閩公雞及復陽雞。

#### (ii) 屠體重測定

雞隻經 CO<sub>2</sub> 迷昏、放血、脫毛、取下腹脂及取出內臟後之屠體重量表示。

#### (iii) 宰率測定

屠體重 / 體重 × 100。

#### (iv) 胸寬測定

測量兩翼內緣間之距離。

#### (v) 腹脂比例測定

腹脂重 / 體重 × 100（腹脂指蓄積在坐骨、華氏囊及砂囊周圍之脂肪）。

#### (vi) 肝臟、砂囊、腸道及心臟比例測定

肝臟、砂囊及心臟重之測定不包含脂肪，腸道重量則包含腸繫膜之脂肪。

器官比例 = 器官重 / 體重 × 100。

#### (vii) 頭頸、腳、腿部、翅膀、背部及胸部比例測定

依 Koch and Possa (1973) 之方法進行頭頸、翅（三節翅）、胸（帶骨帶皮）、背、腿（清腿，帶骨帶皮）及腳六大部位屠體分切。

部位比例 = 部位重 / 屠體重 × 100 表示。

(viii) 蒸煮失重 (cooking loss) 測定

依 Florene *et al.* (1994) 之方法修飾之。將樣品秤重後置入夾鏈帶內，並以錫箔紙包裹後，沈浸於 80°C 水浴池中 25 分鐘，再放在流水中冷卻 15 分鐘，將表面的水分擦乾後秤重，二者間之差即為蒸煮失重。

(xi) 肌肉韌度 (toughness)、內聚力 (cohesion)、彈力 (elastic) 及咀嚼 (chewiness) 之測定

依 Lyon and Lyon (1996) 之方法，將胸肉 (主胸肌, *pectoralis major*) 及腿肉 (縫匠肌, *sartorius*) 裝於夾鏈袋內，並以錫箔紙包裹後，沈浸於 80°C 水浴池中隔水加熱 25 分鐘，再放在流水中冷卻 15 分鐘，將肉順著肌纖維之方向切成 2 × 1 × 1 cm (長 × 寬 × 高) 之長方體肉塊，並以保鮮膜包裹每一肉塊，直至測定為止。以物性測定儀 (Fudoh Rheo meter) chewing test 模式進行測定。

(x) 肌纖維直徑及面積測定

依高及黃 (1988) 之方法測定，測定之肌肉為主胸肌 (*pectoralis major*) 及外側腓肌 (*gastrocnemius pars extrna*)，每個玻片以電腦軟體計算 100 條以上之肌纖維直徑 (短徑距離) 及面積，平均值即為該樣品之肌纖維直徑及面積。

#### IV. 統計分析

試驗所得資料以統計分析系統 (Statistical Analysis System; SAS, 1988) 套裝軟體進行統計分析，使用一般線性模式程序 (General Linear Model Procedure; GLM) 進行變方分析，採用巢式設計 (nested design)，以最小平方均值 (Least Squares Mean; LSMs) 測定法，依期望均方進行檢定，以比較閩公雞、復陽雞及公雞間差異的顯著性。

## 結果與討論

### I. 屠宰率、屠體部位及器官比例

閩公雞、復陽雞及公雞之屠宰率與屠體部位之比較列示於表 1，器官比例之比較列示於表 2。試驗結果顯示，復陽雞之屠宰體重顯著 ( $P < 0.05$ ) 高於公雞，此結果與 Mast *et al.* (1981) 之報告類似，其指稱部分去勢之公雞生長速度較完全去勢或公雞快。屠宰率於三者間呈顯著 ( $P < 0.05$ ) 差異，以公雞為最高，閩公雞為最低。此結果與 Lin and Hsu (2003b) 之結果相符，但與 York and Mitchell (1969) 及陳等 (2000b) 發現閩公雞之屠宰率顯著高於公雞之結果不符。Welter (1976)、Mast *et al.* (1981) 及陳等 (2000a) 之報告顯示，閩公雞與公雞之屠宰率無顯著差異，此可能與閩公雞之內臟蓄積較多量之脂肪致屠宰率降低有關。胸寬於三者間無顯著差異。腹脂比例於三者間呈顯著 ( $P < 0.05$ ) 差異，以閩公雞為最高，公雞為最低。此結果與 York and Mitchell (1969)、Cason *et al.* (1988) 及陳等 (2000a, b) 指稱，閩公雞之腹脂比例顯著較公雞高之結果相符。其原因可能與雄性素可減低家禽脂肪合成酵素之活性有關 (Pearce, 1977)。閩公雞之頭頸比例顯著 ( $P < 0.05$ ) 較復陽雞或公雞為低。此結果與 Field (1971) 及 Seideman *et al.* (1982) 指稱，公畜去勢較未去勢者有較低之頸部比例之結果相似。背部及胸部比例，於三者間呈顯著 ( $P < 0.05$ ) 差異，以閩公雞為最高，公雞為最低，此結果與 Mickelberry (1968) 及 Megally *et al.* (1969) 發現雞隻埋植雌二醇單棕櫚酸鹽 (estradiol monopalmitate) 較未埋植者，擁有較高比例的胸部及背部比例之結果相符。閩公雞之翅膀比例顯著 ( $P < 0.05$ ) 較復陽雞及公雞為高。腿部比例，於三者間呈顯著 ( $P < 0.05$ ) 差異，以公雞最高，閩公雞最低。此結果與陳等 (2000a) 之研究結果相似。Yoshitaka *et al.* (1982) 亦指稱，雄性素可促進雞隻肌肉之生長與蓄積，這種作用以腿部肌肉較明顯。Seideman *et al.* (1982) 亦指稱，公畜去勢較未去勢者有較高之腿部比例。公雞之腳部比例顯著 ( $P < 0.05$ ) 較閩公雞為高。閩公雞之腸道比例顯著 ( $P < 0.05$ ) 較復陽雞及公雞為高，此可能與閩公雞之腸繫膜較易蓄積脂肪有關。閩公雞之脾臟比例顯著 ( $P < 0.05$ ) 較復陽雞為低，此結果與 Fennell *et al.* (1992a, b) 指稱，去勢不影響雞隻或火雞脾臟重量之結果不同。砂囊及肝臟比例於三者間無顯著差異，此結果與 Fennell *et al.* (1992a, b) 指稱，去勢不影響雞隻或火雞肝臟重量之結果相似，但與 Mast *et al.* (1981) 之報告指稱，閩公雞之肝臟比例顯著較公雞高之結果不同。心臟比例，於三者間呈顯著 ( $P < 0.05$ ) 差異，以公雞為最高，閩公雞為最低。此結果與 Miller *et al.* (1985) 及 Fennell and Scanes (1992a, b) 之報告相符，Dube and Trembley (1974) 發現心

臟有雄性素接受器存在，且睪固酮可促進老鼠心肌之發育。公雞之睪丸比例顯著 ( $P < 0.05$ ) 較閩公雞或復陽雞高。屠體部位及器官比例於三者間具有差異之原因，可能與不同屠體部位及器官間所含之雄性素接受器數目及動情素接受器數目不同 (Sauerwein and Meyer, 1989)，及其對雄性素之敏感性不同所致 (Lobley *et al.*, 1987)。而本試驗有些項目測定結果與過去之研究者之研究結果不一致可能與品種不同有關。

表 1. 閩公雞、復陽雞及公雞屠體性狀及屠體部位比列之比較

Table 1. Comparison of capon, slip and intact birds on the dressing and carcass part ratios in Taiwan country chicken cockerels at 28 weeks of age

Items	Capon	Slip	Intact	S.E.
Live weight, g	2,444 <sup>a</sup>	2,426 <sup>ab</sup>	2,232 <sup>b</sup>	41.6
Carcass weight, g	1,981	2,019	1,886	34.4
Dressing, % B.W.	82.6 <sup>c</sup>	84.9 <sup>b</sup>	86.1 <sup>a</sup>	0.24
Chest width, mm	95.7	96.0	94.9	0.88
Abdominal fat weight, % B.W.	2.98 <sup>a</sup>	2.00 <sup>b</sup>	0.62 <sup>c</sup>	0.116
Head and neck weight, % C.W.	9.75 <sup>b</sup>	12.27 <sup>a</sup>	12.76 <sup>a</sup>	0.140
Back weight, % C.W.	21.82 <sup>a</sup>	20.54 <sup>b</sup>	19.07 <sup>c</sup>	0.199
Breast weight, % C.W.	20.08 <sup>a</sup>	18.89 <sup>b</sup>	17.63 <sup>c</sup>	0.164
Wing weight, % C.W.	13.34 <sup>a</sup>	12.49 <sup>b</sup>	12.39 <sup>b</sup>	0.110
Thigh weight, % C.W.	28.92 <sup>c</sup>	29.66 <sup>b</sup>	30.62 <sup>a</sup>	0.147
Feet weight, % C.W.	4.21 <sup>b</sup>	4.25 <sup>ab</sup>	4.48 <sup>a</sup>	0.053

<sup>a, b, c</sup> Means within the same row with the differ superscripts are significantly different ( $P < 0.05$ ).

表 2. 閩公雞、復陽雞及公雞器官比列之比較

Table 2. Comparison of capon, slip and intact birds on the organ ratios in Taiwan country chicken cockerels at 28 weeks of age

Items	Capon	Slip	Intact	S.E.
Gizzard weight, % B.W.	1.67	1.68	1.61	0.034
Heart weight, % B.W.	0.43 <sup>c</sup>	0.51 <sup>b</sup>	0.60 <sup>a</sup>	0.008
Liver weight, % B.W.	1.30	1.24	1.27	0.026
Spleen weight, % B.W.	0.20 <sup>b</sup>	0.27 <sup>a</sup>	0.23 <sup>ab</sup>	0.013
Intestine weight, % B.W.	2.44 <sup>a</sup>	2.16 <sup>b</sup>	2.01 <sup>b</sup>	0.047
Testis weight, % B.W.	0.00 <sup>b</sup>	0.08 <sup>b</sup>	1.19 <sup>a</sup>	0.026

<sup>a, b, c</sup> Means within the same row with the differ superscripts are significantly different ( $P < 0.05$ ).

## II. 肌肉物理性狀

閩公雞、復陽雞及公雞之肌肉物理性狀比較列示於表 3。試驗結果顯示，復陽雞之胸肉蒸煮失重顯著 ( $P < 0.05$ ) 較公雞為低，閩公雞之腿肉蒸煮失重顯著 ( $P < 0.05$ ) 較公雞為低。此可能與復陽雞或閩公雞之肌肉含較高之脂肪有關。我們發現 (林及許, 2013) 發現閩公雞與復陽雞之肌肉脂肪含量，無論在胸肉 (3.26% vs. 1.39% vs. 0.63%) 或腿肉 (6.86% vs. 4.53% vs. 1.66%) 均顯著高於公雞。Sales (1995) 發現肌肉脂肪含量高者，蒸煮失重較脂肪含量低者為低。閩公雞肌肉之韌度顯著 ( $P < 0.05$ ) 低於公雞，且此種差異腿肉比胸肉更明顯。此結果與 Mast *et al.* (1981) 之結果相符。此與閩公雞之肌纖維較細及肌肉含較高之脂肪有關，因肌纖維大小和肉的韌度成正相關 (Herring *et al.*, 1965; Tuma *et al.*, 1962); Sales (1995) 發現肌肉脂肪含量高者，肌肉嫩度較肌肉脂肪含量低者為佳。公雞之胸肉內聚力顯著 ( $P < 0.05$ ) 低於復

陽雞或闖公雞，但腿肉之內聚力於三處理組間無顯著差異。咀嚼性及彈力不論於胸肉或腿肉於三者間均無顯著差異，此結果與林 (1999) 指稱，闖公雞肌肉之內聚力及彈力 (springiness) 顯著較公雞為低之結果不甚相同。闖公雞及復陽雞之主胸肌及外側腓肌之肌纖維直徑及外側腓肌之肌纖維面積，顯著 ( $P < 0.05$ ) 較公雞為小。闖公雞之主胸肌肌纖維直徑顯著 ( $P < 0.05$ ) 較公雞為細，此結果與 Venable (1966) 及 Muller *et al.* (1969) 發現以睪固酮處理可增加肌纖維直徑與 Lin and Hsu (2003a) 及 Lin *et al.* (2011) 指稱闖公雞或復陽雞之肌纖維直徑與面積顯著較公雞為低之結果相符。

表 3. 闖公雞、復陽雞及公雞肌肉物理性狀之比較

Table 3. Comparison of capon, slip and intact birds on the muscle physical properties in Taiwan country chicken cockerels at 28 weeks of age

Items	Capon	Slip	Intact	S.E.
Cooking loss, %				
Breast muscle	26.82 <sup>ab</sup>	25.26 <sup>b</sup>	27.54 <sup>a</sup>	0.41
Thigh muscle	27.78 <sup>b</sup>	31.87 <sup>a</sup>	32.81 <sup>a</sup>	0.76
Toughness, g				
Breast muscle	1,047.0 <sup>b</sup>	1,123.5 <sup>ab</sup>	1,239.7 <sup>a</sup>	31.88
Thigh muscle	1,071.6 <sup>b</sup>	1,249.1 <sup>ab</sup>	1,336.3 <sup>a</sup>	45.96
Cohesiveness, g				
Breast muscle	0.4526 <sup>a</sup>	0.4408 <sup>a</sup>	0.3382 <sup>b</sup>	0.02028
Thigh muscle	0.3394	0.3408	0.3675	0.01836
Elasticity, g				
Breast muscle	0.5412	0.5594	0.4430	0.01261
Thigh muscle	0.4818	0.4801	0.5425	0.01686
Chewiness, g				
Breast muscle	297.6	296.7	233.0	24.94
Thigh muscle	221.7	272.4	279.9	28.17
Muscle fiber diameter, $\mu\text{m}$				
<i>pectoralis major</i>	53.7 <sup>b</sup>	58.1 <sup>b</sup>	66.1 <sup>a</sup>	2.11
<i>gastrocnemius pars extrna</i>	60.1 <sup>b</sup>	63.6 <sup>b</sup>	74.5 <sup>a</sup>	2.63
Muscle fiber area, $\mu\text{m}^2$				
<i>pectoralis major</i>	2,930.0 <sup>b</sup>	3,229.4 <sup>ab</sup>	3,703.2 <sup>a</sup>	228.0
<i>gastrocnemius pars extrna</i>	3,034.1 <sup>b</sup>	3,371.6 <sup>b</sup>	4,999.3 <sup>a</sup>	242.9

<sup>a, b, c</sup> Means within the same row with the differ superscripts are significantly different ( $P < 0.05$ ).

綜合本試驗之結果顯示，雞隻去勢會影響屠宰率、屠體部位與器官比例及肌肉物理性狀，復陽雞各性狀之表現則介於闖公雞和公雞間。

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# Comparison of carcass traits and muscle physical properties of capon, slip and intact birds in Taiwan country chicken cockerels<sup>(1)</sup>

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## Abstract

An experiment was carried out to compare dressing, carcass part and organ ratios and muscle physical properties of capons, slips and intact birds in Taiwan country chicken cockerels. One hundred and seventy-six Taiwan country chicken cockerels were randomly assigned to caponized or intact male groups. Caponized birds were surgically altered at 10 weeks old and raised to 28 weeks old. At 28 weeks of age, the capons were separated into capon and slip groups, depending on the atrophy of the comb and wattle in size, after 24 h of feed deprivation, 16 birds from each group, were weighted, sacrificed and cut. The results showed that intact birds had the highest ( $P < 0.05$ ) dressing, heart and thigh ratios and the lowest ( $P < 0.05$ ) abdominal fat, back and breast ratios followed by slips and capons. The percentage of head and neck were significantly ( $P < 0.05$ ) greater in the intact birds and slips, while the capons had a greater ( $P < 0.05$ ) percentage of intestine and wing. Compared with capons, intact birds had a significantly ( $P < 0.05$ ) greater feet ratio. In addition, the spleen ratio in the capons was significantly ( $P < 0.05$ ) lower than in the slips. Breast width, gizzard and liver ratios were not affected by the treatments. However, the capon had the smallest ( $P < 0.05$ ) muscle toughness, muscle fiber diameter and area followed by slips and intact birds, but was not significantly different in the muscle elasticity and chewiness. Moreover, our findings also indicate that the castration resulted in a significant alteration in carcass and organ traits and muscle physical properties.

Key Words: Caponization, Slip, Carcass traits, Muscle physical properties, Taiwan native chicken.

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