

性別對商用紅羽土雞肉質性狀之影響⁽¹⁾

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摘 要

本研究旨在比較商用紅羽公、母土雞之肉質性狀之差異。選用 288 隻健康且體重相近之出生雛雞，依性別進行分組，每處理 8 重複，每重複 18 隻，試驗為期 13 週。試驗期間提供相同之育雛期 (0 – 4 週齡)、生長期 (5 – 8 週齡) 及肥育期 (9 – 13 週齡) 飼糧與水，供雞隻自由食用。雞隻於 13 週齡經秤活體重後，公、母各屠宰 16 隻，收集雞隻肉質性狀。試驗結果顯示，公雞之屠體重、屠宰率、頭頸、腿部及腳部比例顯著較母雞為高 ($P < 0.05$)，而胸部、背部及翅膀比例顯著較母雞為低 ($P < 0.05$)。而器官方面，母雞之腹脂、砂囊及腸道比例顯著較公雞為高 ($P < 0.05$)。而心臟、肝臟及脾臟比例於性別間，並無顯著差異。公雞胸部皮膚之 L 值及 a 值顯著較母雞高 ($P < 0.05$)，但胸部皮膚之 b 值於性別並無顯著差異。母雞胸肉之脂肪含量顯著較公雞為高 ($P < 0.05$)，但胸肉之水分及蛋白質含量於性別間，並無顯著差異。第二天之滴水失重，母雞胸肉之滴水失重顯著較公雞為高 ($P < 0.05$)，但肌肉蒸煮失重、硬度與韌度及感官品評於兩者間並無顯著差異。綜上結果顯示，雞隻性別顯著影響屠體重、屠宰率與分切部位比例，而對肌肉硬度與韌度及感官品評之影響則不顯著。

關鍵詞：屠體性狀、土雞、性別。

緒 言

肉類是最有營養的食物之一，世界上大多數人民認為肉類是生長和發育的基本元素。在所有動物來源之食物中，雞肉是最受普遍接受的產品，主要是因為禽肉產品不受任何文化影響或宗教限制。另一個方面，雞肉含低脂質和高濃度多不飽和脂肪酸 (Babić *et al.*, 2014)。此外，雞肉被公認富含必需胺基酸的優質廉價蛋白質來源 (如羥丁胺酸、離胺酸、甲硫胺酸、半胱胺酸和色胺酸)，其中包括重要的礦物質和維生素 (Gomez *et al.*, 2020)。研究指出，雞肉品質除了受遺傳影響外 (Nguyen *et al.*, 2020)。飼養因素包括飼養、繁殖和管理 (屠宰前、電昏、屠宰和屠宰後程序、冷藏和儲存條件) 亦會影響雞隻屠體及肉質特性 (Babić *et al.*, 2014; Puspita *et al.*, 2021)。

對於雞隻屠體和肉質，一般常以雞隻屠體重、pH 值和保水性 (WHC) (Nollet and Toldrá, 2008) 來決定。隨著科技進步，為深入了解屠體性，會針對質地與風味相關的核苷酸含量、化學及物理性狀及肌肉顏色等，更加了解雞肉質量特性及其在雞肉生產中的適用性 (Bennato *et al.*, 2020; Warner *et al.*, 2020; Zhang *et al.*, 2020; Sanden *et al.*, 2021; Schreuders *et al.*, 2021)。性別是決定雞肉的物理性狀及雞隻生長和屠體性狀的重要因素 (Cygan- Szczegielniak *et al.*, 2019)。此外，雞隻性別會直接影響雞屠體性狀和肉質參數 (Cömert *et al.*, 2016; Cygan- Szczegielniak *et al.*, 2019; Goo *et al.*, 2019)，通常公肉雞具有較重的活體重及日增重，而這會影響屠體性狀及肌肉品質之相關性狀 (Maiorano *et al.*, 2012; Cygan- Szczegielniak *et al.*, 2019)。

依據行政院農業委員會 2023 年第三季畜禽統計調查結果顯示臺灣肉雞在養數為 49,510,429 隻 (含白肉雞為 25,950,027 隻、紅羽土雞為 14,482,422 隻及黑羽土雞為 9,077,980 隻)，紅羽土雞在養數，占臺灣肉雞在養數近 28.27%，在養數僅次於白肉雞。臺灣土雞一直深受消費者喜愛，尤其是烹調後之肉質甜美及具特殊風味，非常符合國人對美食之要求。為了迎合消費者喜好及降低飼養成本，土雞選種不斷的改良，而商用紅羽土雞在選拔早熟性與生長速度的情形下，是否會造成雞隻肉質性狀改變。

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國內重要的紅羽土雞為了追求肉品質，飼養至接近性成熟，公母體型差異大，然而相關研究不多(李等，1997)。而最近二十多年來商用紅羽土雞改變極大，除了雞冠和體型變大，公母土雞在兩性異形(sexual dimorphism)上的差別，值得深入研究。本研究旨在比較性別對商用紅羽土雞肉質性狀之影響，擬蒐集商用紅羽土雞其屠宰後之器官與部位比例、肌肉組成與物理性質及感官品評，俾做為日後遺傳育種、營養、飼養管理及加工產品等未來研究及實際應用之參考。

材料與方法

本試驗於農業部畜產試驗所南區分所屏東場區場雞舍進行，試驗動物之使用、飼養管理及試驗內容，經畜產試驗所實驗動物管理小組以畜試動字第 101007 號申請核准在案。

I. 試驗動物處理

本試驗採用商用紅羽土雞(臺禽生物科技股份有限公司，臺禽紅色(E))，雛雞於孵化後經公、母鑑別選取健康且活力良好及體重相近之雛雞 288 隻，依性別分為公土雞及母土雞組，每組 8 欄，每欄 18 隻(409 × 192 cm, 2.3 隻/m²)。試驗期間採自然光照及平地(面)飼，飼糧與水供雞隻任食，雞隻各飼養期及飼料成分分別為育雛期(0 - 4 週齡，粗蛋白 22.12%，代謝能 3,136 kcal/kg)、生長期(5 - 8 週齡，粗蛋白 19.7%，代謝能 3,133 kcal/kg)及肥育期(9 - 13 週齡，粗蛋白 17.61%，代謝能 3,133 kcal/kg)，飼糧組成及營養分析值如表 1。試驗期間於第 4 週齡、8 週齡及 13 週齡秤重一次，並記錄雞隻採食量及計算飼料轉換率。

II. 屠體部位及器官比例

本試驗逢機選取 13 週齡之商用紅羽土雞公、母各 16 隻，屠宰前雞隻經禁食 12 小時後，進行個別雞隻秤重。於合格電宰廠(結風食品有限公司)進行雞隻屠宰及振聲農業科技股份有限公司進行屠體性狀調查，屠宰雞隻經電昏、放血、脫毛、取下腹脂及取出內臟後，屠體分切依 Koch and Possa (1973)，雞隻屠體分切為頭頸、腳、胸、背、翅與腿六部分，分切後分別測定其重量，並計算此六部分佔屠體重量百分比及內臟(肝臟、心臟、脾臟等)比例測定。

III. 分析項目

(i) 皮膚與肌肉色澤值測定

依 Lyon *et al.* (1980) 之方法，以色差計(Dr. Lange MC reflectance colorimeter, Germany)測定皮膚與肌肉之色澤，以 CIE L, a, b 值代表肌肉之色度，L 值(表明亮度，範圍介於 0 - 100，0 表示全黑，100 表示全白)、a 值(正值代表紅色度、負值代表綠色度)及 b 值(正值代表黃色度、負值代表藍色度)。胸(breast)部測定左右兩側上下各二個點，各點之平均值即為該部位之色澤值。

(ii) 一般成分分析

將去皮、去骨及去除脂肪之左側胸肉，置於 -20°C 下冷凍。測定時將肌肉樣品置於 4°C 冰箱解凍 24 小時，將胸肉絞碎後，取樣測定之。水分之測定使用空氣乾燥法，脂肪之測定使用 Soxhlet 脂肪萃取器以乙醚萃取之，蛋白質測定使用凱式氮法(Kjeldahl)測定氮百分率，氮百分率轉換至蛋白質百分率以 6.25 為轉換係數，測定方法同飼料之一般成分分析(1986)，參照 AOAC (2000) 之分析方法進行之。

(iii) 肌肉解凍失重(thaw loss)測定

依 Honikel (1998) 之方法測定，取 5 g 之雞里肌 2 塊分置於夾鏈袋中分別冷凍 2 天及 14 天後，個別取出置於 4°C 解凍 12 小時後，將表面的水分擦乾後秤重，二者間之差即為解凍失重。

(iv) 蒸煮失重(cooking loss)測定

依 Florene *et al.* (1994) 之方法修飾之。將右側胸肉秤重後置入夾鏈帶內，並以錫箔紙包裹後，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。

(v) 肌肉韌度(toughness)及硬度(firmness)之測定

參考 Lyon and Lyon (1996) 之方法，於肌肉解凍後，將肌肉置於耐高溫密封袋中，浸於 80°C 水浴槽中 25 分鐘，再放在流水中冷卻 15 分鐘後，將肉順著肌纖維之方向(與肌纖維方向平行)切成 2 × 1 × 1 cm³(長 × 寬 × 高)之長方體肉塊，肉塊以保鮮膜包裹直至測定為止。以肌肉物性測定儀(Texture Analyser)(TA.XT-Plus, Stable Micro Systems, UK)進行肌肉硬度及韌度測定。韌度為表達樣品壓縮、折曲、扭曲與拉伸等之綜合性質，意即肌肉之韌度越大則表示其抵抗壓縮、折曲、扭曲與拉伸等不同型式之外力能力越強。硬度為表達使樣品破裂所需之力量。

表 1. 試驗飼糧組成

Table 1. The composition of the experimental diets

Items	Starter 0 – 4 weeks old	Grower 5 – 8 weeks old	Finisher 9 – 13 weeks old
Ingredients, %			
Yellow corn	55.75	59.72	64.26
Soybean meal (43.5%)	2.00	14.50	14.00
Soybean meal without hull	22.20	—	—
Full soybean meal	—	—	15.70
Full soybean meal without hull	12.50	22.50	—
Fish meal (65%)	2.50	—	—
Wheat meal	—	—	2.80
L-Lysine.HCl	0.03	—	0.01
DL-Methionine	0.13	0.08	0.04
Salt	0.40	0.40	0.40
Soybean oil	1.68	—	—
Limestone pulverized	1.33	1.45	1.37
Dicalcium phosphate	1.23	1.10	1.22
Choline-50%	0.05	0.05	—
Premix	0.20	0.20	0.20
Calculate value, %			
Crude protein	22.12	19.70	17.61
ME, kcal/kg	3,136.00	3,133.00	3,133.00
Crude fat	6.25	6.24	5.57
Crude fiber	2.69	3.27	3.23
Calcium	0.99	0.93	0.86
Total phosphorus	0.68	0.61	0.58
Available phosphorus	0.46	0.37	0.35
Lysine	1.28	1.05	0.92
Methionine	0.48	0.38	0.32
Analyzed value, %			
Crude protein	22.05	18.80	18.10
Crude fat	6.99	6.67	5.78
Crude fiber	2.44	2.39	2.88
Calcium	1.09	1.01	0.95
Total phosphorus	0.64	0.56	0.57
Lysine	1.14	1.06	0.92
Methionine	0.40	0.34	0.28
Feed cost, NT\$/kg	22.59	20.57	19.57

* Supplied per kilogram of diet: Vitamin A, 10,000 IU; Vitamin D₃, 1,000 IU; Vitamin E, 25 IU; Vitamin K₃, 3 mg; Vitamin B₁, 3 mg; Riboflavin B₂, 5 mg; Vitamin B₆, 3 mg; Vitamin B₁₂, 0.03 mg; Folic acid, 3 mg; Calcium pantothenate, 10 mg; Niacin, 50 mg; Biotin, 0.1 mg; Iron, 70 mg; Copper, 5 mg; Manganese, 60 mg; Zinc, 60 mg; Selenium, 0.1 mg.

(vi) 肌肉感官品評

將冰凍之胸肉於 0 – 4°C 冰箱進行解凍 24 小時後，將各別之胸肉以鋁箔紙包覆後置於 85°C 水浴槽下水煮約 20 – 30 分鐘，當肌肉中心溫度達 80°C 後取出，將肌肉切成約 1/2 英吋 (1.3 cm) 立方體大小之肉塊，並將肉塊放置於溫暖之隔熱容器直至進行感官品評為止。以 10 位人員進行感官品評，每位品評人員分別從

各處理組之樣品中選取一塊肌肉進行品評。品評項目包括香氣 (aroma)、顏色、咬感 (chewing)、風味 (flavor) 及總接受性 (overall acceptability)。採七分法，1 至 7 分表示，由非常不喜歡至非常喜歡。

VI. 統計分析

試驗所得資料以統計分析系統 (statistical analysis system) 套裝軟體 (SAS, 2013) 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，以最小平方均值 (least squares mean, LSM) 測定法比較各處理組間差異的顯著性。

結果與討論

I. 屠體性狀

性別對商用紅羽土雞屠體部分及器官比例之影響，其結果列示於表 2。在屠體部分方面，公雞之活體重、屠體重、屠宰率、頭頸、腿部及腳部比例均顯著高於母雞 ($P < 0.05$)；母雞之胸部、背部及翅膀比例均顯著高於公雞 ($P < 0.05$)；在器官方面，性別對心臟、肝臟及脾臟比例均無顯著 ($P > 0.05$) 之影響；母雞之砂囊、腸道及腹脂比例均顯著高於公雞 ($P < 0.05$)。Mignon-Grasteau 及 Beaumont (2000) 報告指出，這些差異是與母禽比公禽早熟有關。進一步的證實，肌肉纖維橫截面積的分析與禽類年齡有關，母禽在身體發育較公禽早 (Baéza *et al.*, 2012)。Lopez *et al.* (2011) 研究表示，公肉雞的屠宰重、活體重和胸重均高於母肉雞 ($P < 0.05$)，但胸肉產量和胸肉量較低 ($P < 0.05$)。胸肉產量隨禽類的屠宰年齡和性別而變化。母雞的胸肉產量高於公雞，而公雞的腿肉較母雞多。De Marchi *et al.* (2005) 報告胸部和大腿產量的類似結果。

表 2. 商用紅羽土雞不同性別之屠體部位及器官比例比較

Table 2. Comparison of male and female birds on the dressing and carcass part and organ ratio in red-feathered Taiwan Country chickens at 13 weeks of age

Items	Male	Female	SE
Live weight, g	3,396 ^a	2,735 ^b	45.08
Carcass weight, g	2,899 ^a	2,254 ^b	36.84
Dressing, % B.W.	85.47 ^a	82.44 ^b	0.44
Head and neck weight,% C.W.	18.38 ^a	16.08 ^b	0.30
Thigh weight,% C.W.	32.47 ^a	30.31 ^b	0.23
Feet weight,% C.W.	5.75 ^a	4.67 ^b	0.07
Breast weight,% C.W.	23.43 ^b	27.04 ^a	0.36
Back weight,% C.W.	9.52 ^b	10.94 ^a	0.17
Wing weight,% C.W.	10.37 ^b	10.88 ^a	0.08
Organ ratio			
Heart weight, % B.W.	0.46	0.45	0.01
Liver weight, % B.W.	1.25	1.41	0.05
Spleen weight, % B.W.	0.16	0.17	0.01
Gizzard weight, % B.W.	2.03 ^b	2.60 ^a	0.08
Intestine weight, % B.W.	2.17 ^b	3.20 ^a	0.06
Abdominal fat weight, % B.W.	0.77 ^b	1.80 ^a	0.18
Testis weight, % B.W.	0.81	—	0.06

^{a, b} Means within the same row without the same superscripts are significantly different ($P < 0.05$).

B.W.: Body weight; C. W.: Carcass weight.

II. 對肌肉色澤之影響

性別對商用紅羽土雞之胸肉皮膚及肌肉色澤之影響，列示於表 3。在皮膚色澤方面，公雞之 L 值及 a 值顯著 ($P < 0.05$) 較母雞高，但在 b 值上性別間則無顯著 ($P > 0.05$) 差異；在肌肉方面，公雞之 L 值顯著 ($P < 0.05$) 較母雞高，但在 a 與 b 值則是母雞較公雞顯著高 ($P < 0.05$)。Hillebrand *et al.* (1996) 之研究顯示，影響肉類色澤的直接

與間接因素包括脂肪含量及肉中之色素含量。Solberg *et al.* (1968) 指稱，肉類色澤受肌肉中肌紅蛋白 (myoglobin) 與肌血紅蛋白 (myohemoglobin) 之影響。Musundire *et al.* (2017) 指出，珍珠雞 (*Numida meleagris* L.) 母雞的脂肪沈積量多會導致其肉較黃。Hill and Dansky (1951) 指稱，肌肉顏色與屠體色素或脂肪含量成正相關。影響皮膚與肌肉色澤之因素很多，例如品種、年齡、飼養管理 (飼糧成分、採食量等)、pH 值、肌紅色素之狀態、脂肪含量、肉中之色素含量及屠宰方式 (電擊或迷昏) 及貯存時間等 (Hillebrand *et al.*, 1996; Alcalde and Negueruela, 2001)。

表 3. 商用紅羽土雞不同性別土雞胸部皮膚及肌肉顏色之比較

Table 3. Comparison of male and female birds on the breast skin and muscle color in red-feathered Taiwan Country chickens at 13 weeks of age

Items	Male	Female	SE
Breast skin			
L value	76.11 ^a	73.96 ^b	0.26
a value	1.32 ^a	0.35 ^b	0.23
b value	9.16	8.81	0.09
Breast muscle			
L value	62.54 ^a	59.76 ^b	0.48
a value	0.46 ^b	1.07 ^a	0.17
b value	5.10 ^b	7.65 ^a	0.29

^{a, b} Means within the same row without the same superscripts are significantly different ($P < 0.05$).

III. 肌肉組成

性別對商用紅羽土雞胸肉及腿肉之肌肉組成比較，列示於表 4。試驗結果顯示，在胸肉方面，母雞肌胸肉脂肪含量較公雞肌胸肉含量顯著高 ($P < 0.05$)，而水分及蛋白質含量性別間無顯著性差異。而在腿肉方面，公雞之水分含量顯著 ($P < 0.05$) 較母雞多，而不同性別之腿肉蛋白質與脂肪含量間無顯著性差異。Fennell and Scanes (1992) 指稱，雄性素在雞隻可抑制脂肪之蓄積，其結果與本試驗相似。

表 4. 商用紅羽土雞不同性別土雞肌肉組成比較

Table 4. Comparison of male and female birds on the muscle compositions in red-feathered Taiwan country chickens at 13 weeks of age

Items	Male	Female	SE
Breast muscle, %			
Moisture	74.11	74.17	0.04
Protein	24.80	24.70	0.09
Fat	0.60 ^b	1.19 ^a	0.09
Thigh muscle, %			
Moisture	75.39 ^a	74.23 ^b	0.12
Protein	21.18	21.46	0.12
Fat	2.33	3.02	0.17

^{a, b} Means within the same row without the same superscripts are significantly different ($P < 0.05$).

IV. 對胸肉物理性狀之影響

表 5 列示性別對商用紅羽土雞胸肉物理性狀之結果。試驗結果顯示，母雞在第二天之滴水失重較公雞多，而在第 14 天之滴水失重方面，公母雞間無顯著性差異。而胸肉之蒸煮失重、韌度及硬度，性別間無顯著性差異。Musundire *et al.* (2017) 研究指出，性別對珍珠雞胸肌中測量的剪切力值沒有影響，這與本研究結果一致。肉的嫩度和多汁性很大程度上取決於白肌纖維和紅肌纖維的比例和直徑。肌纖維的直徑通常與肉的剪切力相關 (Bernacki *et al.*, 2012)。Seideman (1986) 指出，肌肉物理性狀受肌肉組成之影響，主要為脂肪與膠原蛋白之含

量。研究指出，雞體重重、胸肉產量或腹部脂肪少的雞隻，其胸肉表現出具有較高 pH 值、色澤深及較高保水能力 (Le Bihan-Duval *et al.*, 1999; Berri *et al.*, 2001)。本試驗有相同的結果，公雞體重重其保水能力較母雞佳。

表 5. 商用紅羽土雞不同性別土雞胸肉物理性質之比較

Table 5. Comparison of male and female birds on the physical properties in the breast muscles in red-feathered Taiwan country chickens at 13 weeks of age

Items	Male	Female	SE
Drip loss at d 2, %	0.20 ^b	0.35 ^a	0.02
Drip loss at d 14, %	2.99	3.22	0.25
Cooking loss, %	22.97	23.72	0.76
Firmness, kg	4.07	3.70	0.35
Toughness, kgsec	6.24	6.19	0.20

^{a, b} Means within the same row without the same superscripts are significantly different ($P < 0.05$).

V. 胸肉肌肉感官品評物理性狀之影響

性別對商用紅羽土雞胸肉感官品評之影響，列於表 6。試驗結果顯示，胸肉感官品評之香氣 (aroma)、顏色、咬感 (chewing)、風味 (flavor) 及總接受性 (overall acceptability) 等，性別間並無顯著差異。母雞在感官品評上有較公雞佳之趨勢，肉的風味和味道主要是由熟產的，因為未煮熟的肉幾乎無香味或香氣。肉只有在經過烹飪過程以及瘦肉和脂肪組織的不同非揮發性化合物之間發生的一系列熱誘導的複雜反應後才會變得美味。肉的風味和味道受到年齡、性別和基因型的影響，因其對脂質含量和成分有影響 (Baéza *et al.*, 2022)。陳等 (2000) 的研究結果指出，以感官品評方式無法區分臺灣土雞之公雞、母雞及闖雞之總接受度的差別，其結果與本試驗相似。

表 6. 商用紅羽土雞不同性別土雞對肌肉感官品評之影響

Table 6. Comparison of male and female birds on the muscle sensory panel score in red-feathered Taiwan country chickens at 13 weeks of age

Items	Male	Female	SE
Aroma	4.35	4.36	0.16
Colorness	3.90	4.03	0.12
Chewing	3.78	3.92	0.11
Flavor	3.80	4.21	0.15
Overall acceptability	4.45	4.51	0.14

由本研究結果顯示，商用紅羽土雞之性別對體重、屠宰率與部位比例及脂肪蓄積有顯著性影響，而對肌肉硬度與韌度及感官品評之影響則不顯著。

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參考文獻

- 中華民國國家標準－飼料檢驗法。1986。行政院經濟部標準檢驗局，臺北市。
 行政院農業委員會。2023。畜禽統計調查結果。<https://agrstat.coa.gov.tw/sdweb/public/book/Book.aspx>。
 李淵百、江碧玲、黃暉煌。1997。臺灣土雞最適上市週齡之研究。中畜會誌 26(3)：285-296。

- 陳國隆、吳建平、洪炎明。2000。臺灣土雞之閹雞與公雞、母雞屠體性狀與肌肉品質之比較。中畜會誌 29(1)：77-88。
- AOAC. 2000. Official Methods of Analysis (17th Ed.) Association of Official Analytical Chemists, Washington, D. C.:Association Official Analytical Chemists.
- Alcalde, M. J. and A. I. Negueruela. 2001. The influence of final conditions on meat colour in light lamb carcasses. Meat Sci. 57: 117-123.
- Baéza, E., C. Arnould, M. Jlali, P. Chartrin, V. Gigaud, F. Mercierand, C. Durand, K. M'éteau, E. Le Bihan-Duval, and C. Berri. 2012. Influence of increasing slaughter age of chickens on meat quality, welfare and technical and economic results. JAS 90: 2003-2013.
- Baéza, E., L. Guillier, and M. Petracci. 2022. Review: Production factors affecting poultry carcass and meat quality attributes. Animal 16: 100331.
- Babi'c, J., D. Mili'cevi'c, D. Vrani'c, M. Luki'c, and Z. Petrovi'c. 2014. The effect of season of transportation on the welfare of broilers and selected parameters of broiler meat quality. Tehnol. Mesa 55: 46-53.
- Baéza, E., C. Arnould, M. Jlali, P. Chartrin, V. Gigaud, F. Mercierand, C. Durand, K. Méteau, E. Le Bihan-Duval, and C. Berri. 2012. Influence of increasing slaughter age of chickens on meat quality, welfare, and technical and economic results. JAS. 90: 2003-2013.
- Bennato, F., A. Di Luca, C. Martino, A. Ianni, E. Marone, L. Grotta, S. Ramazzotti, A. Cichelli, and G. Martino. 2020. Influence of grape pomace intake on nutritional value, lipid oxidation and volatile profile of poultry meat. Foods 9: 508.
- Bernacki, Z., M. Bawej, and D. Kokoszyński. 2012. Carcass composition and breast muscle microstructure in guinea fowl (*Numida meleagris* L.) of different origin. Folia Biol. 60: 175-179.
- Berri, C., N. Wacrenier, N. Millet, and E. Le Bihan-Duval. 2001. Effect of selection for improved body composition on muscle and meat characteristics of broilers from experimental and commercial lines. Poult. Sci. 80: 833-838.
- Cömert, M., Y. Sayan, F. Kırkpınar, Ö. H. Bayraktar, and S. Mert. 2016. Comparison of carcass characteristics, meat quality, and blood parameters of slow and fast grown female broiler chickens raised in organic or conventional production system. Anim Biosci. 29: 987-997.
- Cygan-Szczegielniak, D., G. Maiorano, B. Janicki, B. Buzał, K. Stasiak, K. Stanek, K. Roślewsk, G. Elminowska-Wenda, J. Bogucka, and S. Tavaniell. 2019. Influence of rearing system and sex on carcass traits and meat quality of broiler. J. Appl. Anim. Res. 47: 333-338.
- Dalle Zotte, A., G. Tasoniero, G. Baldan, and M. Cullere. 2019. Meat quality of male and female Italian Padovana and Polverara slow-growing chicken breeds. Ital. J. Anim. Sci. 18: 398-404.
- De Marchi, M., M. Cassandro, E. Lunardi, G. Baldan, and P. B. Siegel, 2005. Carcass characteristics and qualitative meat traits of the Padovana breed of chicken. Int. J. Poult. Sci. 4: 233-238.
- Fennell, M. J. and C. G. Scanes. 1992. Inhibition of growth in chickens by testosterone, 5 α -dihydrotestosterone, and 19-nortestosterone. Poult. Sci. 71: 357-366.
- Florene, G., C. Touraille, A. Oual, M. Renerre, and G. Moni. 1994. Relationships between postmortem pH changes and some traits of sensory quality in veal. Meat Sci. 37: 315-325.
- Gomez, D. L., G. Kòsa, L. D. Hansen, L. T. Mydland, and V. Passoth. 2020. Production and characterization of yeasts grown on media composed of spruce-derived sugars and protein hydrolysates from chicken by-products. Microb. Cell Factories 19: 19.
- Goo, D., J. H. Kim, H. S. Choi, G. H. Park, G. P. Han, and D. Y. Kil. 2019. Effect of stocking density and sex on growth performance, meat quality, and intestinal barrier function in broiler chickens. Poult. Sci. 98: 1153-1160.
- Hill, F. W. and L. M. Dansky. 1951. Influence of diet on body composition of growing chicks. Cornell Nutrition Conference for Feed Manu factures, Proc. 27-32.
- Hillebrand, S. J. W., E. Lambooy, and C. H. Veerkamp. 1996. The effects of alternative electrical and mechanical stunning methods on hemorrhaging and meat quality of broiler breast and thigh muscles. Poult. Sci. 75: 664-671.
- Honikel, K. O. 1998. Reference methods for the assessment of physical characteristics of meat. Meat Sci. 49: 447-457.
- Koch, T. and E. Possa. 1973. Anatang of the chicken and domestic birds. Humboldt University, West German., P.12.
- Lopez, K. P., M. W. Schilling, and A. Corzo. 2011. Broiler genetic strain and sex effects on meat characteristics. Poult. Sci. 90: 1105-1111.

- Le Bihan-Duval, E., N. Millet, and H. Re'mignon. 1999. Broiler meat quality: Effect of selection for increased carcass quality and estimates of genetic parameters. *Poult. Sci.* 78: 822-826.
- Lyon, L. E., B. G. Lyon, C. E. Davis, and W. E. Townsend. 1980. Texture profile analysis of patties made from mixed and flake-cut mechanically deboned. *Poult. Sci.* 59: 69-76.
- Lyon, C. E. and J. A. Cason. 1995. Effect of Water Chilling on Objective Color of Bruised and Unbruised Broiler Tissue. *Poult. Sci.* 74: 1894-1899.
- Lyon, B. G. and C. E. Lyon. 1996. Texture evaluations of cooked, diced broiler breast samples by sensory and mechanical methods. *Poult. Sci.* 75: 812-819.
- Maiorano, G., A. Sobolewska, D. Cianciullo, K. Walasik, G. Elminowska-Wenda, A. Slawinska, S. Tavaniello, J. Zylinska, J. Bardowski, and M. Bednarczyk. 2012. Influence of in ovo prebiotic and symbiotic administration on meat quality of broiler chickens. *Poult. Sci.* 91: 2963-2969.
- Mignon, G. S. and C. Beaumont. 2000. Birds growth curves. *INRA Animal* 13: 337-348.
- Musundire, M. T., T. E. Halimani, and M. Chimonyo. 2017. Physical and chemical properties of meat from scavenging chickens and helmeted guinea fowls in response to age and sex. *Brit. Poult. Sci.* 58: 390-396.
- Nguyen Van, D., N. Moula, E. Moyse, L. Do Duc, T. Vu Dinh, and F. Farnir. 2020. Productive Performance and Egg and Meat Quality of Two Indigenous Poultry Breeds in Vietnam, Ho and Dong Tao, Fed on Commercial Feed. *Animals* 10: 408.
- Nollet, L. M. and F. Toldrá. 2008. *Handbook of Processed Meats and Poultry Analysis*; CRC Press: Boca Raton, FL, USA.
- Puspita, U. E., H. Saragih, T. Hartatik, and B. S. Daryono. 2021. Body Weight Gain and Carcass Quality of the Hybrid Chicken Derived from the Crossing between Female F1 Kampung Super and Male F1 Kampung-Broiler. *JTBB* 6: 60934.
- Sanden, K. W., U. Böcker, R. Ofstad, M. E. Pedersen, V. Høst, N. K. Afseth, S. B. Rønning, and N. Pleshko. 2021, Characterization of collagen structure in normal, wooden breast and spaghetti meat chicken fillets by FTIR micro spectroscopy and histology. *Foods* 10: 548.
- SAS. 2013. *SAS user guide: Statistics*. SAS Inst., Cary, NC.
- Schreuders, F. K., M. Schlangen, K. Kyriakopoulou, R. M. Boom, and A. J. van der Goot. 2021. Texture methods for evaluating meat and meat analogue structures: A review. *Food Control.* 127: 108103.
- Seideman, S. C. 1986. Methods of expressing collagen characteristics and their relationship to meat tenderness and muscle fiber types. *J. Food Sci.* 51: 273-276.
- Solberg, L. A., P. A. McGarry, J. Moossy, J. P. Strong, C. Tejada, and A. C. Löken. 1968. Severity of atherosclerosis in cerebral arteries, coronary arteries, and aortas. *The New York academy of sciences* 149: 588-1068.
- Warner, R. D., F. M. Clarke, and J. M. Hughes. 2020. Variations in meat color due to factors other than myoglobin chemistry; a synthesis of recent findings (invited review). *Meat Sci.* 159: 107941.
- Zhang, J., H. Hu, T. Mu, W. Wang, B. Yu, J. Guo, Y. Wang, Z. Zhou, Y. Gu, and Z. Huang. 2020. Correlation analysis between AK1 mRNA expression and inosine monophosphate deposition in Jingyuan chickens. *Animals* 10: 439.

Effects of sex on the meat traits of red-feathered Taiwan country chickens ⁽¹⁾

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Abstract

The experiment was conducted to compare the meat traits of male and female commercial red feather native chickens. The experiment selected 288 healthy chicks with similar body weight, which were randomly assigned into groups by sex, allocated into 8 repeats of 18 chickens per repeat. All chickens were provided with the same starter (0-4 weeks of age), grower (5-8 weeks of age) and finisher (9-13 weeks of age) diets. Feed and water were provided and feeding was *ad libitum* for 13-week experimental period. At 13 weeks of age, 16 male and female chickens each were weighed alive and then butchered to collect the meat traits of chicken. The results showed that the carcass weight, carcass yield, head and neck part, thigh and feet in male chickens were significantly ($P < 0.05$) higher than the female chickens. With regards to organs, the abdominal fat, gizzards, and intestines of female chickens were significantly higher ($P < 0.05$) than those of male chickens. However, there was no significant difference in the percentage of hearts, liver, and spleen by sex.

Compared with female chickens, male chickens had a significantly higher ($P < 0.05$) L and a value in the breast skin. However, there was no difference in the b value in the breast skin. The fat content in the breast meat of female chicken was significantly higher than that of male chickens ($P < 0.05$) while the water and protein content of breast meat showed no significant difference by sex. With regards to drip loss, the drip loss in the breast of female chickens was significantly higher ($P < 0.05$) than those male chickens. Nonetheless, there was no significant difference in the cooking loss in breast muscles, hardness, resilience, and sensory analysis between the male and female chicken. In conclusion, the sex of chicken significantly affected the carcass weight, carcass yield, and ratio of cut parts, but did not have significant impact on the muscle hardness and sensory analysis.

Key words: Carcass traits, Native chicken, Sex.

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