

外科去勢對公台灣土雞血液性狀之影響⁽¹⁾

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摘要

本試驗旨在探討外科去勢對公台灣土雞血液性狀之影響。試驗選用畜試土雞台畜肉十三號公雞 176 隻，逢機分為去勢與未去勢處理組，每處理四重複，每重複一欄 22 隻。雞隻於 10 週齡時以外科手術去勢，並餵給生長期飼料（10 至 18 週齡）及肥育期飼料（19 至 28 週齡），試驗期間每隔 2 週每組逢機採血 20 隻雞，供測定血液性狀之用。試驗結果顯示，正常公雞之睪固酮（testosterone）、尿酸（uric acid）、總羥脯胺酸（total hydroxyproline）等濃度與血球比容積（packed cell volume）及血漿 pH 值顯著（ $P < 0.05$ ）高於閹公雞，而血漿抑血鈣素（calcitonin）、離子鈣（ionized calcium）、鉀離子（ K^+ ）、無機磷（inorganic phosphorus）、總蛋白質（total protein）、白蛋白（albumin）、球蛋白（globulin）、三酸甘油酯（triglyceride）、總膽固醇（total cholesterol）、低密度脂蛋白（low density lipoprotein）與高密度脂蛋白（high density lipoprotein）等濃度及肌酸激酶（creatine kinase）活性則顯著（ $P < 0.05$ ）低於閹公雞。血漿甲狀腺素（thyroxine）、副甲狀腺素（parathyroid hormone）、鈉離子（ Na^+ ）、氯離子（ Cl^- ）、總鈣（total calcium）、鎂（magnesium）、肌酸酐（creatinine）、尿素氮（urea nitrogen）、乳酸（lactic acid）與游離羥脯胺酸（free hydroxyproline）等濃度及鹼性磷酸酶（alkaline phosphatase）活性，在二者間並無顯著差異。

關鍵詞：公台灣土雞、外科去勢、血液性狀

緒言

閹雞性情較溫馴、活動性較低及擁有肥美的肉質（嫩而多汁），有關閹雞之技術在中外書籍中被記載已超過 2,000 年（鄒，1995; Winter and Funk, 1960; Stromberg, 1980）。台灣閹雞之飼養，均採用有色雞隻（俗稱土雞），與國外明顯不同。公雞去勢會變更性成熟過程及生產結果，已有許多有關的文獻被

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報導，諸如去勢或睪固酮處理對生長（陳等，2000b; York and Mitchell, 1969; Welter, 1976; Mast *et al.*, 1981; Cason *et al.*, 1988; Burke and Edwards, 1994; Lin and Hsu, 2002; Lin and Hsu, 2003a）、屠體（陳等，2000a; 謝等，2001a; 郭及林，2001; Welter, 1976; Yoshitaka *et al.*, 1982; Lin and Hsu, 2003b）、血液（謝等，2001a; 謝等，2001b; 郭及林，2001; Griggs *et al.*, 1986; Griggs *et al.*, 1989; Vanderschueren *et al.*, 1992; Gill *et al.*, 1998; Mauras *et al.*, 1999）、骨骼（Hutt, 1929; Landauer, 1937; Pierson *et al.*, 1981; Griggs *et al.*, 1989; Vanderschueren *et al.*, 1992; Burke and Edwards, 1994; Gill *et al.*, 1998; Mauras *et al.*, 1999; Lin and Hsu, 2003a）、肌肉顏色（Cason *et al.*, 1987; Lin and Hsu, 2003b）、組成（Mast *et al.*, 1981; Lin *et al.*, 2011）、物理性質（陳等，2000a; Mast *et al.*, 1981; Lin and Hsu, 2002; Lin and Hsu, 2003a; Lin *et al.*, 2010）與官能品評（USDA, 1977; Mast *et al.*, 1981; Lin *et al.*, 2011）及行為（林，1999; 王，2001）。但有關去勢對血液性狀影響之報告則較不完整。動物各項血清或血漿成分之濃度可做為動物健康與生理狀況及營養利用情形等之參考（Karasawa, 1984; Bogin, 1992）。因此本試驗旨在探討外科去勢對台灣土雞血液性狀之影響，以建立其基本資料，提供業界參考及學界進一步研究之用。

材料與方法

I. 試驗動物與試驗設計

本試驗選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 176 隻，逢機分為去勢與未去勢處理組，每處理四重複，每重複一欄 22 隻。公雞於 10 週齡去勢，去勢前禁食 24 小時，飲水照常給與。在 10 至 18 週齡，餵給含蛋白質 19%，代謝能 3,000 kcal/kg 之生長期飼料，於 19 至 28 週齡，餵給含蛋白質 17%，代謝能 2,800 kcal/kg 之肥育期飼料，飼糧組成如表 1。雞隻依一般飼養管理方法飼養，試驗期間飲水與飼料採任食，給予 23 小時光照，每二週採血一次，每處理組各採血 20 隻。採血前禁食 12 小時，採血器每 mL 加入 50 μ L 內含 heparin-Li 1,000 IU/mL 之 0.15 *M* NaCl 溶液，從翼靜脈採血，採血完成後離心 30 分鐘（1500 G，5°C），將血漿分裝 3 瓶，一瓶貯存於 4°C 供血漿 pH、離子鈣（ionized calcium, Ca^{2+} ）、鈉（ Na^{+} ）、鉀（ K^{+} ）與氯（ Cl^{-} ）離子及肌酸激酶（creatine kinase, CK）之測定，其他 2 瓶貯存於 -20°C 供其他血液性狀測定。

II. 測定項目與方法

(i) 血球比容積（packed cell volume, PCV）

以含肝素之毛細管（長 75mm，內徑 1.1mm），於採血當時吸取全血，並以黏土密封一側，置於離心機中，以 13362 \times g 離心 5 分鐘，以比例尺讀取數值。

(ii) 血漿總鈣（total calcium, Ca）、無機磷（inorganic phosphorus, P）、鎂（magnesium, Mg）、鹼性磷酸酶（alkaline phosphatase, ALP）、肌酸激酶（creatine kinase, CK）、尿酸（uric acid, UA）、尿素氮（Urea nitrogen, UN）、肌酸酐（creatinine, CREA）、總蛋白質（total protein, TP）、白蛋白（albumin, ALB）、球蛋白（globulin, GLOB）、三酸甘油酯（triglyceride, TG）、總膽固醇（total cholesterol, TCHO）、高密度脂蛋白（high density lipoprotein, HDL）、低密度脂蛋白（low density lipoprotein, LDL）及乳酸（lactic acid, LACT）濃度或活性

使用試劑套組（Wako, Japan），以血液自動分析儀（Hitachi 7050, Japan）測定之。

(iii) 血漿 pH 值、離子鈣（ionized calcium, Ca^{2+} ）、鈉（ Na^{+} ）、鉀（ K^{+} ）與氯（ Cl^{-} ）離子濃度

使用試劑套組（Bayer, UK），分別以離子鈣及酸鹼值分析儀（634 ISE Ca^{2+} /pH Analyzer, Ciba Corning, England）與鈉、鉀、氯離子分析儀（644 ISE $\text{Na}^{+}/\text{K}^{+}/\text{Cl}^{-}$ Analyzer, Ciba Corning,

表 1. 試驗飼糧組成

Table 1. The composition of the experimental diets

Items	Grower (10-18 weeks old)	Finisher (19-28 weeks old)
Ingredients, %		
Yellow corn	65.07	62.77
Soybean meal, 43.5%	28.50	16.50
Fish meal, 65%	2.50	—
Corn gluten meal, 61%	—	5.00
Wheat bran	—	11.00
Alfalfa meal, 17%	—	1.80
Limestone, pulverized	1.40	1.35
Dicalcium phosphate	0.50	0.85
Salt	0.40	0.40
L-Lysine.HCL	—	0.10
DL-Methionine	0.03	0.03
Soybean oil	1.40	—
Premix*	0.20	0.20
Calculated value, %		
Crude protein	19.12	17.18
ME, kcal/kg	3008	2813
Calcium	0.82	0.81
Available phosphorus	0.30	0.30
Analyzed value, %		
Crude protein	19.56	17.07
Calcium	0.78	0.79
Total phosphorus	0.48	0.59

* Supplied per kilogram of diet: Vitamin A, 10,000 IU; Vitamin D₃, 2,000 ICU; Vitamin E, 15 mg; Vitamin K₃, 4 mg; Vitamin B₁, 2 mg; Vitamin B₂, 6 mg; Vitamin B₆, 4 mg; Vitamin B₁₂, 0.02 mg; Niacin, 40 mg; Pantothenic acid, 12mg; Folic acid, 1 mg; Biotin, 0.1mg; Fe, 80 mg; Cu, 10 mg; Mn, 55 mg; Zn, 45 mg; I, 0.3 mg; Se, 0.1 mg.

England) , 於採血後 72 小時內測定。

(iv) 血漿總羥脯胺酸 (total hydroxyproline) 及游離羥脯胺酸 (free hydroxyproline) 濃度

依 Bergman and Loxley (1963) 及 Bannister and Burns (1970) 之方法測定。

(v) 血漿睪固酮、抑血鈣素 (calcitonin, CT) 、副甲狀腺素 (parathyroid hormone, PTH) 及甲狀腺素 (thyroxine, T4) 濃度

使用不同之 ELISA 試劑套組 (HUMAN T4 ; ACTIVE CT, DSL-10-7700 ; ACTIVE PTH, DSL-10-8000 and NEOGEN Testosterone ELISA kit) 以 ELISA reader (MRX Dynex Technologies, USA) 測定之。

III. 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，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

外科去勢對公台灣土雞血液血球比容積、血漿 pH 值與血漿睪固酮、甲狀腺素、副甲狀腺素及抑血鈣素濃度之影響，列示於表 2。試驗結果顯示，正常公雞之血球比容積、血漿 pH 值及睪固酮濃度顯著（ $P < 0.001$ ）高於閹公雞，血漿抑血鈣素濃度則顯著（ $P < 0.05$ ）低於閹公雞。血漿甲狀腺素與副甲狀腺素濃度於正常公雞與閹公雞間則無顯著差異，但正常公雞之血漿甲狀腺素濃度有較閹公雞高之趨勢（ $P < 0.10$ ）。本試驗之結果與 Pierson *et al.*（1981）、Burke and Edwards（1994）及 Gill *et al.*（1998）指稱，公畜去勢導致血清睪固酮濃度顯著降低；Lin and Hsu（2003）及 Chen *et al.*（2005）指出，閹公雞之血漿睪固酮濃度顯著低於正常公雞之結果相符。本試驗結果亦與 Sturkie and Textor（1960）指出閹公雞之血球比容積介於公雞與母雞之間；白等（2000）指稱，雄性烏骨雞（Silkie）之血液血球比容積顯著較雌雞高；Griggs *et al.*（1989）指稱，男人以睪固酮處理 6 個月後，血液血球比容積顯著較未處理者高之結果相吻合。Griggs *et al.*（1989）指稱，男人以睪固酮處理 6 個月後不影響甲狀腺素濃度，及 Stewart and Washburn（1983）指稱，公雞之血液甲狀腺素濃度高於母雞；Mauras *et al.*（1999）指稱，罹患性腺功能低下症（hypogonadism）之男人，睪固酮濃度顯著降低，但血清副甲狀腺素濃度並無顯著變化，本試驗結果與之相似。Moggetti *et al.*（1999）發現以 GnRH 拮抗劑處理或以 GnRH 拮抗劑併用抗雄性素藥物處理 6 個月後，睪固酮濃度顯著降低，但血清抑血鈣素濃度顯著提高；Stepan and Lachman（1989）之研究顯示，去勢會導致血清抑血鈣素濃度顯著增加，本試驗結果與之相符。Burton and Smith（1972）指稱，動情素會抑制紅血球生成之作用，而雄性素則有促進紅血球生成之作用。閹公雞之血漿抑血鈣素濃度顯著較正常公雞高之原因，可能與閹公雞之血漿離子鈣濃度顯著較正常公雞為高有關。抑血鈣素由後腮腺（ultimobranchial gland）所分泌，當血液中離子鈣濃度上升，抑血鈣素分泌亦增加，以抑制骨質之移動，降低血液中離子鈣濃度，以維持血液中鈣之恆定（Simkiss, 1975）。骨骼中有副甲狀腺素受體，副甲狀腺素可激活破骨細胞促使骨質溶解，而釋出離子鈣和磷酸鹽，並增加腎臟對離子鈣的再吸收，促進磷酸鹽的排泄及加速 $1,25(\text{OH})_2\text{-D}_3$ 之合成。因此當血液中離子鈣濃度降低時，副甲狀腺素濃度上升，以維持血液中離子鈣濃度平衡。睪固

表 2. 外科去勢對公台灣土雞血球比容積、血漿 pH 值與睪固酮、甲狀腺素、副甲狀腺素及抑血鈣素濃度之影響

Table 2. Effects of surgical castration on packed cell volume, plasma pH and plasma testosterone, thyroxine, calcitonin and parathyroid hormone concentration of male Taiwan country chickens

Items	Capon	Male	S.E.	P
Testosterone, pg/mL	157.7 ^b	1328.3 ^a	87.92	<0.001
Packed cell volume, %	29.2 ^b	37.9 ^a	0.22	<0.001
Plasma pH	7.53 ^b	7.60 ^a	0.005	<0.001
Thyroxine, µg/dL	1.26	1.51	0.210	<0.10
Calcitonin, pg/mL	15.4 ^a	10.8 ^b	0.84	<0.05
Parathyroid hormone, pg/mL	.15 1	13.6	1.92	>0.05

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

酮可增加骨骼細胞對副甲狀腺素之敏感性及抑制副甲狀腺素分泌 (Vanderchursen and Bouillion, 1995)，而本試驗亦發現閹公雞之血漿 PTH 濃度比正常公雞高 11 %。Puche and Romano (1968; 1969) 證實，睪固酮可促進家禽骨骼鈣化及骨骼組織的合成。本試驗結果亦顯示睪固酮可促進雞隻之造血及骨骼同化。白等 (2000) 指稱，烏骨雞 (Silkie) 之血液 pH 值於性別間無顯著差異。閹公雞為何有較低之血漿 pH 值，其原因並不清楚，有待進一步探討。但可能與去勢導致肌纖維型態比例及肌肉代謝型態改變有關，因去勢會使 α -紅色肌纖維比例提高， α -白色肌纖維比例降低 (Asmore, 1974)，而 α -紅色肌纖維具較強之脂肪氧化能力，較低之醣降解能力，可能導致血液中之有機(酮)酸增加，致血漿 pH 降低。

表 3 列示外科去勢對公台灣土雞血漿離子鈣、鈉、鉀及氯離子濃度之影響。結果顯示，正常公雞之血漿離子鈣與鉀離子濃度顯著 ($P < 0.001$) 低於閹公雞。血漿鈉及氯離子濃度於正常公雞與閹公雞間並無顯著差異。此結果與 Lin and Hsu (2003a) 發現閹公雞之血漿離子鈣濃度顯著高於正常公雞相符；亦與白等 (2000) 指稱，雄性烏骨雞 (Silkie) 之血清鉀及氯離子濃度顯著較雌雞為低，但血清鈉離子濃度於性別間無顯著差異之結果相似。Hervey *et al.* (1981) 及 Sturkie (1986) 發現雄性素可促進體內氮、鉀及磷之滯留。閹公雞之血漿離子鈣濃度顯著較正常公雞高之原因，可能與雄性素具有增加骨骼蓄積 (bone

表 3. 外科去勢對公台灣土雞血漿離子鈣與鈉、鉀及氯離子濃度之影響之影響

Table 3. Effects of surgical caponization on plasma Ca^{2+} , Na^+ , K^+ and Cl^- concentration of male Taiwan country chickens

Items	Capon	Male	S.E.	P
Ca^{2+} , mmol/L	1.68 ^a	1.50 ^b	0.030	<0.001
Na^+ , mmol/L	150.5	150.6	0.23	>0.05
K^+ , mmol/L	4.39 ^a	3.50 ^b	0.035	<0.001
Cl^- , mmol/L	112.2	111.5	0.23	>0.05

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

deposition) 及抑制骨骼溶解 (antiresorption effects) 與再造 (skeletal remodeling) 之功能有關 (Vanderchursen and Bouillion, 1995; Katzneelson *et al.*, 1996; Gill *et al.*, 1998; Hofbauer *et al.*, 1999; Pederson *et al.*, 1999)。

外科去勢對公台灣土雞血漿總鈣、無機磷與鎂離子等濃度及鹼性磷酸酶活性之影響，列示於表 4。試驗結果顯示，正常公雞之血漿無機磷濃度顯著 ($P < 0.001$) 低於閹公雞。血漿總鈣與鎂離子濃度及鹼性磷酸酶活性於正常公雞與閹公雞間則無顯著差異。本試驗與 Lin and Hsu (2003a) 發現閹公雞之血漿無機磷濃度顯著高於正常公雞，但血漿總鈣與鎂離子等濃度及鹼性磷酸酶活性於閹公雞及正常公雞間並無顯著差異之結果相符。亦與 Chen *et al.* (2007) 指出，閹公雞之血液無機磷濃度顯著較正常公雞高，但總鈣濃度及鹼性磷酸酶活性於閹公雞與正常公雞間並無顯著差異之結果一致。Mauras *et al.* (1999) 指稱，罹患性腺功能低下症之男人，血清睪固酮濃度顯著降低，但鹼性磷酸酶活性並無顯著變化；Moggetti *et al.* (1999) 發現以 GnRH 拮抗劑處理或以 GnRH 拮抗劑併用抗雄性素藥物處理 6 個月後，血清睪固酮濃度顯著降低，但鈣及無機磷之濃度則顯著提高；而 Vanderschueren *et al.* (1992) 及 Gill *et al.* (1998) 之研究顯示，去勢會導致血清無機磷濃度增加，但對鈣濃度並無顯著影響，本試驗結果與其結果相似。Turner *et al.* (1989) 及 Wakley *et al.* (1981) 指稱，大鼠去勢會增加骨骼組成的流失，但可藉由補充睪固酮或 DHT 來改善，而骨骼之礦物質組成中，以碳酸鈣含量最高，磷酸鈣及磷酸鎂分居二、三位。Lin and Hsu (2003a) 之報告指稱，閹雞之脛骨皮層厚度、骨骼灰分、鈣及磷含量，顯著較未去勢公雞低，顯示去勢會導致骨骼之礦物質溶解釋出，導致血中離子鈣及無機磷濃度增加。本試驗結果顯示，閹公雞血漿

表 4. 外科去勢對公台灣土雞血漿總鈣、無機磷與鎂離子濃度及鹼性磷酸酶活性之影響

Table 4. Effects of surgical caponization on plasma total calcium, inorganic phosphorus, magnesium concentration and alkaline phosphatase activities of male Taiwan country chickens

Items	Capon	Male	S.E.	P
Total calcium, mg/dL	10.08	10.08	0.234	>0.05
Inorganic phosphorus, mg/dL	5.2 ^a	4.2 ^b	0.074	<0.001
Magnesium, mg/dL	2.19	2.16	0.099	>0.05
Alkaline phosphatase, U/L	1551.3	1136.8	354.87	>0.05

^{a, b} Means within the same row without the same superscript are significantly different

之離子鈣濃度顯著較正常公雞高，但總鈣濃度於二者間並無顯著差異，因此建議在血鈣濃度分析上，採用離子鈣比總鈣敏感。

表 5 列示外科去勢對公台灣土雞血漿總蛋白質、白蛋白、球蛋白、三酸甘油酯、總膽固醇、低密度脂蛋白及高密度脂蛋白等濃度之影響。結果顯示，正常公雞之血漿總蛋白質、白蛋白、球蛋白、三酸甘油酯、總膽固醇、低密度脂蛋白及高密度脂蛋白等濃度均顯著 ($P < 0.05$) 低於閹公雞。此結果與謝等 (2001a) 指稱，閹公雞之血漿總蛋白質及總膽固醇濃度顯著較正常公雞高及 Weiss and Fisher (1959) 與 Fuller and Wilson (1975) 指稱，閹公雞血清總膽固醇濃度較正常公雞為高；Fillious (1957) 及 Fuller and Wilson (1975) 指稱，閹公雞之血清三酸甘油酯濃度顯著較正常公雞為高之結果一致；亦與 Chen *et al.* (2005) 指出，閹公雞血液之三酸甘油酯、總膽固醇、低密度脂蛋白及高密度脂蛋白濃度顯著 ($P < 0.05$) 高於正常公雞之結果相符。閹公雞之血漿三酸甘油酯及總膽固醇較正常公雞為高之原因，可能與閹公雞較正常公雞肥胖有關，此可由腹脂比例 (2.9 % vs. 0.6 %) 及肌肉脂肪含量 (5.1 % vs. 1.2 %) 以閹公雞顯著較正常公雞為高得到印證 (Lin and Hsu, 2003a; Lin *et al.*, 2010)。Bogin (1992) 指稱，肥胖會造成高血脂；且雄性素可抑制雞隻脂肪蓄積 (Deyhim *et al.*, 1992; Fennell and Scanes, 1992a; Fennell *et al.*, 1996) 及降低家禽脂肪合成酵素活性 (謝等, 2002; Pearce, 1977) 有關。本試驗亦與蔡等 (2002) 指稱，閹公雞之血漿白蛋白濃度顯著較正常公雞為高之結果一致。閹公雞之血漿白蛋白濃度較正常公雞為高之原因可能與閹公雞血漿之三酸甘油酯及總膽固醇濃度顯著較正常公雞為高，致需要較多之白蛋白來運輸脂質有關。而閹公雞血漿球蛋白濃度顯著較正常公雞為高之原因，可能與睪固酮會抑制胸腺、華氏囊及脾臟 (免疫器官) 發育有關 (Vasilakis *et al.*, 1974; Vojtkova *et al.*, 1976; Mashaly, 1984; Fennell and Scanes, 1992b)。閹公雞之血漿總蛋白質濃度顯著較正常公雞為高之原因，目前仍不清楚，但可能與閹公雞較正常公雞肥胖，需較多之脂蛋白來運輸脂質有關，且閹公雞之血漿白蛋白及球蛋白濃度均顯著較正常公雞為高，因此閹公雞之血漿總蛋白質濃度顯著較正常公雞為高，為合理之現象。閹公雞之血漿低密度脂蛋白及高密度脂蛋白濃度顯著較正常公雞高之原因，可能與閹公雞之血漿總膽固醇濃度顯著較正常公雞高有關。

表 5. 外科去勢對公台灣土雞血漿總蛋白質、白蛋白、球蛋白、三酸甘油酯、總膽固醇、低密度脂蛋白及高密度脂蛋白濃度之影響

Table 5. Effects of surgical caponization on plasma total protein, albumin, globulin, triglyceride, total cholesterol, low density lipoprotein and high density lipoprotein concentration of male Taiwan country chickens

Items	Capon	Male	S.E.	P
Total protein, mg/dL	4.48 ^a	4.41 ^b	0.041	<0.001
Albumin, mg/dL	1.8 ^a	1.5 ^b	0.07	<0.05
Globulin, mg/dL	3.0 ^a	2.5 ^b	0.16	<0.05
Triglyceride, mg/dL	23.5 ^a	19.1 ^b	0.90	<0.05
Total cholesterol, mg/dL	132.2 ^a	95.0 ^b	1.24	<0.001
Low density lipoprotein, mg/dL	41.4 ^a	30.9 ^b	2.64	<0.001
High density lipoprotein, mg/dL	88.2 ^a	56.2 ^b	3.93	<0.001

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

外科去勢對公台灣土雞血漿肌酸酐、尿酸、尿素氮、乳酸、總羥脯胺酸與游離羥脯胺酸等濃度及肌酸激酶活性之影響，列示於表 6。結果顯示，正常公雞之血漿肌酸激酶活性顯著 ($P < 0.05$) 低於閹公雞，血漿尿酸及總羥脯胺酸濃度顯著 ($P < 0.05$) 高於閹公雞。血漿肌酸酐、尿素氮、乳酸及游離羥脯胺酸濃度於正常公雞與閹公雞間則無顯著差異，但正常公雞之血漿肌酸酐濃度則有較閹公雞高之趨勢 ($P < 0.10$)。閹公雞血漿肌酸激酶活性顯著較正常公雞高之原因，可能與閹公雞性情較膽怯 (王，2001)，易造成緊迫有關 (Field, 1971)。Bogin (1992) 指出，肌酸激酶與動物之緊迫狀態有關，動物處於緊迫狀態下其血漿肌酸激酶活性會提高。謝等 (2001a) 指稱，閹公雞之血清尿酸濃度顯著較正常公雞低，本試驗結果與之相符。閹公雞血漿尿酸濃度顯著較正常公雞低之原因，可能與閹公雞於 18 至 28 週齡間之飼料利用效率較正常公雞佳有關 (Lin and Hsu, 2002)。家禽由於缺乏尿素循環中所必須的胺基甲醯磷酸合成酶 (carbamoyl phosphate synthetase)，故無法如哺乳動物般合成尿素，而以尿酸型態為體內氮化合物的主要終產物 (Karasawa, 1984)，因此血漿尿酸濃度可做為家禽對蛋白質利用情形之指標。閹公雞之血漿肌酸酐濃度較正常公雞低之原因，可能與睪固酮可促進肌肉合成與蓄積有關，這可由正常公雞之肌肉蛋白質含量顯著較閹公雞高 (22.4 % vs. 21.3 %) 得到印證 (Lin *et al.*, 2010)。Forebs (1985) 及 Griggs *et al.* (1989) 指稱，血清肌酸酐濃度可作為瘦肉率之衡量指標，血清肌酸酐濃高者，瘦肉率亦較高。Bogin (1992) 發現血清肌酸酐濃度高者，肌肉量亦較高。Robins (1982) 指稱，羥脯胺酸為在形成膠原蛋白時由脯胺酸轉變而來，為膠原蛋白測定之衡量指標，且血中羥脯胺酸含量可反應細胞外的膠原蛋白濃度。Gerrard *et al.* (1987) 發現閹公牛血清羥脯胺酸濃度顯著較公牛低，本試驗結果與之相符。

本試驗結果顯示，正常公雞之血球比容積、血漿 pH 值與睪固酮、尿酸及總羥脯胺酸濃度顯著 ($P < 0.05$) 高於閹公雞；而血漿抑血鈣素、離子鈣、鉀離子、無機磷、總蛋白質、白蛋白、球蛋白、三酸甘油酯、總膽固醇、低密度脂蛋白、高密度脂蛋白濃度及肌酸激酶活性則顯著 ($P < 0.05$) 低於閹公雞。血漿甲狀腺素、副甲狀腺素、鈉與氯離子、總鈣、鎂、肌酸酐、尿素氮、乳酸與游離羥脯胺酸濃度及鹼性磷酸酶活性於正常公雞與閹公雞間則無顯著差異，但正常公雞之血漿甲狀腺素及肌酸酐濃度有較閹公雞為高之趨勢 ($P < 0.10$)。

表 6. 外科去勢對公台灣土雞血漿肌酸酐、尿酸、尿素氮、乳酸、總羥脯胺酸與游離羥脯胺酸等濃度及肌酸激酶活性之影響

Table 6. Effects of surgical caponization on plasma creatinine, uric acid, urea nitrogen, lactic acid, total hydroxyproline and free hydroxyproline concentration and creatine kinase activities of male Taiwan country chickens

Items	Capon	Male	S.E.	P
Creatine kinase, U/L	183.7 ^a	165.4 ^b	4.71	<0.05
Creatinine, mg/dL	0.414	0.427	0.0048	<0.10
Uric acid, mg/dL	4.46 ^b	6.14 ^a	0.161	<0.05
Urea nitrogen, mg/dL	3.0	3.1	0.39	>0.05
Lactic acid, mg/dL	65.2	71.2	6.78	>0.05
Total hydroxyproline, µg/mL	8.6 ^b	10.3 ^a	0.33	<0.05
Free hydroxyproline, µg/mL	6.0	6.9	0.35	>0.05

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

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Effects of surgical caponization on blood characteristics of male Taiwan country chickens⁽¹⁾

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Abstract

This experiment was conducted to determine the effect of caponization on blood characteristics of male Taiwan Country Chickens. A total of one hundred and seventy-six 10-wk-old LRI native chicken cockerels, Taishi meat No.13, from LRI-COA were used as experimental animals. Cockerels were surgically caponized at ten weeks of age. Birds were fed grower (10 to 18 wk) and finisher (19 to 28 wk) diet *ad libitum* during the eighteen week experimental period. Twenty birds from each groups were bleed from 12 to 28 wk of age by 2 wk interval. The results showed that packed cell volume, plasma pH, testosterone, uric acid and total hydroxyproline concentration were significantly ($P < 0.05$) higher in intact males while capons had a higher ($P < 0.05$) plasma calcitonin, ionized calcium, K^+ , inorganic phosphorus, total protein, albumin, globulin, triglyceride, total cholesterol, high density lipoprotein, low density lipoprotein concentrations, and creatine kinase activities. However, the plasma thyroxine, parathyroid hormone, sodium, chloride, total calcium, magnesium, creatinine, urea nitrogen, lactic acid and free hydroxyproline concentrations and alkaline phosphatase activities were not affected.

Key words: Male Taiwan country chickens, Surgical caponization, Blood characteristics.

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