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Comparison of Growth Performance and Carcass Component Yield of a New Strain of Tom Turkeys to Other Commercial Strains

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Abstract: A nineteen week experiment was conducted to evaluate a newly developed strain of toms, (British United Turkeys of America T2), compared to the currently available strains from other genetic sources (Hybrid Converter and Nicholas 700). The T2 strain grew more slowly during the brooding (0 to 5-wk) stage compared to the other two strains. At both slaughter ages (17 and 19 wk), the T2 birds were the heaviest and Nicholas 700 toms were heavier than Hybrid Converter toms. Feed conversion was not significantly different between strains at slaughter ages. Livability was higher for the Hybrid toms compared to the other two strains. Toms were selected for carcass component analysis based upon similar weights across strains at 17 wk and average BW for each strain at 19 wk of age. Regardless of slaughter age, breast yield was higher and thigh and drumstick yield were lower for T2 toms compared to the other two strains. Wing yield was consistently lower and breast skin was higher for Hybrid toms. Mortality due to cardiovascular disease was higher for Nicholas 700 toms due primarily to round heart incidence from 2 to 5 wk of age. The T2 tom strain reached market weight earlier and yielded more premium priced meat than other commercial strains at heavy market weights.

Key words: Growth performance, strain, tom, turkey, yield

Introduction

During the 1990's, the average time required for a tom turkey grown in the U.S. to reach a target live weight of 16 kg has decreased by about 1.5 d annually (Ferket, 2001). Growth performance enhancements have also been accompanied by significant changes in the composition and component yields of turkey carcasses (Lilburn and Nester, 1991).

There are three dominant turkey genetic companies in the world that provide elite genetic stock (British United Turkeys, Hybrid Turkeys, and Nicholas Turkey Breeding Farms), and each merchandises one or more strains that have differing performance attributes and market targets. Choice of strain by production companies is based upon marketing goals and the ability of the genetic properties of the birds to match feeding, health and husbandry practices.

Independent research on growth performance and carcass component yields of tom turkeys has been reported sparsely over the past 20 yr and strains are often compared within different feeding systems or regimens (Moran *et al*., 1984; Warnick, 1988; Brake *et al*., 1995; Waldroup *et al*., 1997). The three dominant tom strains used in the U.S. during the past 5 yr (British United Turkeys of America Big 6, Hybrid Converter, and Nicholas 700) were evaluated recently, but there was no clear significant difference between these strains in the experiment when toms were grown to 17 kg (Roberson *et al*., 2003). British United Turkeys has developed a new strain of tom called T2 that has been bred for further enhancements in growth and breast yield traits.

The objective of this study was to evaluate growth performance and carcass parameters of T2 toms in comparison to other common strains of toms used in U.S. turkey production when raised under similar conditions. Growth performance was measured periodically to 19 wk of age and yield of component parts was determined at 17 and 19 wk of age.

Materials and Methods

A total of 800 male poults were procured from a commercial hatchery[1] and placed the same day of hatch into pens with soft wood shavings and supplemental heat. The poults were housed at 50 poults per pen at placement and were divided in half to equalized body weights at 2 wk of age. There were 4 pens per strain for Hybrid Converter and Nicholas 700 poults the first two weeks and 8 pens per strain the remainder of the trial. There were 8 pens and 16 pens respectively during the same time period for the British United Turkeys of America (BUTA) T2 toms. Initial plans were to also use BUTA Big 6 toms, but this strain was not available from the same hatchery at the time of the experiment. Weeks in lay of the breeder hens for the different strains were 21 for Hybrid, 19 for Nicholas, and 6 for BUTA. Eggs were managed similarly prior to incubation.

All birds were fed the same feed which met or exceeded NRC (1994) recommendations for all nutrient requirements for each of 7 phases (Table 1). The feed formulations are similar to turkey diets fed in the Midwestern U.S. Feed was provided in the mash form for 2 wk and as crumbles from 2 to 5 wk of age. Pellets

Table 1: Composition (%) of the experimental diets for each phase fed to commercial tom strains

Ingredient	0-2 wk	2-5 wk	5-8 wk	8-11 wk	11-14 wk	14-17 wk	17-19 wk
Ground yellow corn	45.95	42.80	50.20	55.65	61.70	64.55	67.80
Soybean meal, dehulled	44.20	40.15	32.55	26.05	19.90	16.45	12.40
Fish meal, menhaden	3.00	0.00	0.00	0.00	0.00	0.00	0.00
Wheat middlings	0.00	5.00	6.00	7.00	7.25	7.50	7.50
Meat and bone meal, porcine	0.00	3.50	3.50	3.50	3.50	3.00	3.00
Choice white grease	1.95	0.00	0.00	0.00	0.00	0.00	0.00
Animal/vegetable fat	0.00	4.66	4.45	4.67	4.86	6.07	7.13
Dicalcium phosphate	2.48	1.86	1.54	1.36	1.14	0.98	0.80
Limestone	1.30	0.87	0.76	0.72	0.65	0.61	0.55
Salt	0.27	0.30	0.30	0.30	0.30	0.31	0.31
Sodium bicarbonate	0.10	0.05	0.05	0.05	0.05	0.05	0.05
DL-methionine (99%)	0.27	0.00	0.00	0.00	0.00	0.00	0.00
Methionine-HA (88%)[1]	0.00	0.24	0.18	0.17	0.15	0.10	0.06
L-lysine-HCl	0.18	0.24	0.22	0.28	0.25	0.13	0.15
Vitamin premix[2]	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Trace mineral premix[3]	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Choline Cl (60%)	0.05	0.03	0.00	0.00	0.00	0.00	0.00
Calculated nutrient analysis							
Crude protein, %	27.00	26.00	23.00	20.50	18.00	16.20	14.50
ME, kcal/kg	2900	3000	3060	3125	3200	3300	3400
Lysine, %	1.80	1.65	1.43	1.30	1.10	0.90	0.80
Methionine + cystine, %	1.14	1.05	0.88	0.80	0.72	0.63	0.55
Calcium, %	1.40	1.32	1.18	1.10	1.00	0.88	0.80
Nonphytate phosphorus, %	0.70	0.66	0.59	0.55	0.50	0.44	0.40
Analyzed nutrient analysis							
Crude protein, %	27.58	26.39	22.67	20.76	18.16	16.95	15.55

[1]Methionine Hydroxy analogue (Alimet®), Novus International, St. Charles, MO 63304. [2]Vitamin premix provided per kg diet: vitamin A (all-trans-retinyl acetate), 11,000 IU; cholecalciferol, 5,000 ICU; vitamin E (all-rac-α-tocopherol acetate), 35 IU; menadione (as menadione sodium bisulfite), 2.75 mg; riboflavin, 10 mg; Ca pantothenate, 20 mg; nicotinic acid, 80 mg; vitamin B_{12}, 0.025 mg; vitamin B_6, 4.3 mg; thiamin (as thiamin mononitrate), 2.9 mg; folic acid, 2.2 mg; biotin, 0.2 mg; vitamin C, 0.10 g; selenium, 0.275 mg; and ethoxyquin, 125 mg. [3]Mineral premix supplied per kg of diet: manganese, 100 mg; zinc, 100 mg; iron, 50 mg; copper, 10 mg; iodine, 1 mg.

(4.76 mm diameter) were fed from 5 to 19 wk of age. The pre-starter feed (0-2 wk of age) was mixed at the Michigan State University feed mill and textured feed was manufactured by a commercial feed mill[2]. Diets were analyzed for nitrogen[3] content to estimate crude protein. The temperature and lighting programs were administered similar to commercial standards in the Midwestern U.S. The lighting program consisted of 24 h of light until 6 d of age. Day length was decreased by 1 h every day afterward until the birds were 15 d of age. At that point, the birds received 16L:8D until the toms were marketed. Room temperature was set at 28.3°C the first wk with heat lamps providing 35-37.8°C underneath the lamps. Heat lamps were removed after 8 d. Temperature was reduced to 26.7°C at 19 d of age and was reduced by 2.7°C each wk until the birds were 52 d of age in which the temperature was set at 15.6°C and maintained there until market.

Body weight was measured on a pen basis at placement and at 2 wk of age. The toms were weighed individually at 5, 11, 17 and 19 wk of age. Feed intake was estimated by feed disappearance from each pen and feed conversions were calculated. Feed conversion is expressed as net or adjusted, where weight gain is adjusted for mortality. Feed intake was estimated on a pro rata basis for each treatment pen in relation to the 2-wk group brooding period as treatment pens consisted of two groups of birds from each brood pen. Net feed conversion was feed intake of each pen divided by the body weight gain of live birds. Adjusted feed conversion added the weight of dead birds to the total body weight of the pen, which resulted in lower feed conversion. A diagnosis for mortality was recorded when birds died during the trial.

At 17 wk of age, three toms per pen that weighed approximately 17.75 kg were selected for carcass component analysis. At 19 wk of age, three birds per pen that weighed similar to the mean body weight of the pen were selected for carcass component analysis. The birds were deprived of feed for 10 h before slaughter but had access to water. Birds were transported to the campus processing facility for the slaughter at 17 wk and were transported for approximately 1 h to a commercial processing facility for slaughter at 19 wk of

Table 2: Effect of tom strain on growth performance traits and livability of market toms

Parameter	Hybrid Converter	Nicholas 700	BUTA[1] T2	avg	SEM	trt, p<
Body Weight						
Wk						
0 (g)	56.7[b]	59.8[a]	59.0[a]	58.7	0.1	0.005
2 (g)	380[a]	380[a]	352[b]	366	4	0.001
5 (kg)	1.99[b]	2.07[a]	1.94[c]	1.99	0.01	0.001
11 (kg)	8.68[c]	9.19[a]	9.00[b]	8.97	0.05	0.001
17 (kg)	16.35[c]	17.46[b]	18.11[a]	17.59	0.09	0.001
19 (kg)	18.69[c]	20.29[b]	21.63[a]	20.56	0.12	0.001
Cumulative Feed:Gain (Net)						
2 wk	1.228[b]	1.299[a]	1.329[a]	1.296	0.010	0.001
5 wk	1.354[b]	1.359[b]	1.375[a]	1.366	0.006	0.033
11 wk	1.923	1.930	1.954	1.940	0.014	0.260
17 wk	2.469	2.498	2.515	2.499	0.025	0.449
19 wk	2.634	2.679	2.701	2.679	0.033	0.367
Cumulative Feed:Gain (Adjusted)						
2 wk	1.222[c]	1.279[b]	1.326[a]	1.288	0.006	0.001
5 wk	1.351[b]	1.347[b]	1.373[a]	1.361	0.005	0.002
11 wk	1.914	1.882	1.934	1.916	0.015	0.074
17 wk	2.424	2.362	2.396	2.395	0.019	0.155
19 wk	2.512	2.468	2.492	2.491	0.015	0.228
Livability (%) 19 wk	95.9[a]	85.5[b]	89.6[b]	90.1	1.6	0.002
Mortality/Culls (%)						
Cardiovascular	1.54[b]	9.29[a]	4.04[b]	4.73	1.41	0.007
Loco motor	0.52	2.11	1.27	1.29	0.68	0.371

[a-c]Means within a row with no common superscript differ significantly ($p < 0.05$). [1]British United Turkeys of America

age. Birds were slaughtered and eviscerated manually following standard commercial procedures. Hot carcass weights were determined within 15 min of slaughter and carcasses were chilled for 4 h in ice water.

After being chilled, individual carcasses were drained and weighed, and the carcasses were cut up into components and weighed. Carcass yield was expressed as a percentage of the live body weight just before slaughter, and carcass components were expressed as a percentage of the chilled carcass weight (without giblets). At the 19 wk slaughter, breast meat was deponed into pectoralis major and pectoralis minor muscles. The color of breast meat was determined on the posterior surface of the skinless pectoralis muscle at the top and medial portions of the muscle tissue with a Chroma Meter[4] (Model CR-310).

The data were analyzed by ANOVA using the general linear models procedure of SAS software (SAS Institute, 2003) using pen as the experimental unit for growth performance measurements and bird for carcass analyses. Separation of treatment means were by the Student-Newman-Kuels test. Mortality related data were transformed with the arcsine transformation prior to analyses (Steel and Torrie, 1980).

Results and Discussion

Hybrid poults were lighter at placement than the other two strains, but were similar to Nicholas poults and heavier than BUTA poults at 2 wk of age (Table 2). The BUTA poults were lighter than other strains at 5 wk, but were intermediate at 11 wk (lighter than Nicholas and heavier than Hybrid) and were heavier than other strains at 17 and 19 wk. Nicholas birds were heavier than Hybrid turkeys at 11, 17 and 19 wk of age. Feed conversion (feed:gain) was lower for Hybrid poults at 2 wk of age compared to the other two strains. Feed conversion was higher for BUTA poults at 5 wk of age. However, there were no significant effects on feed conversion during the remainder of the experiment. Livability was higher for Hybrid turkeys at the end of the experiment compared to the other strains. Mortality and culls due to cardiovascular problems were higher for Nicholas turkeys compared to Hybrid and BUTA toms. There were no differences in mortality/culls due to leg problems.

Research 20 yr ago showed that Nicholas toms grew faster than BUTA Big 6 toms at early ages, but BUTA toms grew faster during the last half of the grow-out and were heavier at market time (Moran *et al.*, 1984). Fast early growth was also observed in a more recent report (Roberson *et al.*, 2003) for Hybrid tom poults. Previous studies have reported no significant differences in growth performance of tom strains at market age (Waldroup *et al.*, 1997; Roberson *et al.*, 2003). Although

Table 3: Effect of tom strain on carcass and component yields

Parameter	Hybrid Converter	Nicholas 700	BUTA[1] T2	avg	SEM	trt, p<
17 wk						
Live BW (kg)	17.69	17.81	17.77	17.76	0.07	0.578
Hot carcass wt (kg)	13.15	13.32	13.30	13.27	0.06	0.179
Cold carcass wt (kg)	13.37	13.61	13.54	13.52	0.07	0.084
Hot yield (%)	74.27	74.80	74.87	74.71	0.23	0.193
Cold yield (%)	75.55	76.42	76.22	76.11	0.24	0.067
Water pick-up (%)	1.72	2.17	1.80	1.88	0.13	0.061
Components (%)						
Breast	29.85^{b}	29.68^{b}	31.01^{a}	30.39	0.27	0.001
Wing	10.94^{b}	11.73^{a}	11.98^{a}	11.67	0.11	0.001
Thigh	19.04^{a}	19.10^{a}	17.87^{b}	18.46	0.14	0.001
Drumstick	13.83^{a}	13.79^{a}	13.34^{b}	13.57	0.14	0.019
Breast skin	3.21^{a}	2.61^{b}	2.67^{b}	2.78	0.09	0.001
Bone	22.81	22.78	22.86	22.83	0.22	0.966
19 wk						
Live BW (kg)	19.29	20.47	21.20	20.54	0.10	0.001
Hot carcass wt (kg)	14.96	16.01	16.53	16.01	0.10	0.001
Cold carcass wt (kg)	15.25	16.32	16.89	16.34	0.10	0.001
Hot yield (%)	77.57	78.24	77.98	77.94	0.25	0.245
Cold yield (%)	79.07	79.72	72.61	79.50	0.26	0.233
Water pick-up (%)	1.93	1.89	2.08	2.00	0.13	0.538
Components (%)						
Breast	29.57^{b}	29.73^{b}	31.04^{a}	30.34	0.24	0.001
P. major	24.27^{b}	24.20^{b}	25.40^{a}	24.82	0.24	0.001
P. minor	5.30	5.39	5.60	5.47	0.10	0.069
Wing	10.21^{b}	10.76^{a}	11.01^{a}	10.75	0.10	0.001
Thigh	18.14^{b}	18.80^{a}	17.09^{c}	17.78	0.16	0.001
Drumstick	12.82^{a}	12.98^{a}	12.37^{b}	12.64	0.12	0.002
Breast skin	7.54^{a}	6.04^{b}	6.20^{b}	6.50	0.18	0.001
Bone	21.01^{b}	21.07^{b}	21.54^{a}	21.29	0.18	0.049

$^{a-c}$Means within a row with no common superscript differ significantly ($p < 0.05$). [1]British United Turkeys of America

growing toms to heavier weights (18-20 kg) can result in more differences in body weight between strains, strain effects were clearly observed at 17 wk of age in this experiment in which birds were closer to what is considered "consumer" or "canner" tom weight in the U.S. The body weight results of this study are consistent with growth patterns currently observed by turkey producers in the Midwestern U.S.

The improved livability of Hybrid toms in this study is related to lower incidence of heart attacks and dissecting aneurysms during the last half of the experiment compared to Nicholas and BUTA toms. Total mortality due to cardiovascular problems was higher for Nicholas toms than other strains due to the additional high incidence of round heart disease in Nicholas poults during the 2 to 5 wk feeding period in which crumbles were provided. Although a higher incidence of leg problems due to spontaneous femur fractures has been reported in the U.S. turkey industry for Nicholas toms, there were no differences in loco motor disorders between strains in this experiment.

There were no differences in carcass yield at 17 wk of age when toms were selected to have similar body weights or at 19 wk of age when live body weight of the three strains were different (Table 3). However, breast yield was higher for BUTA T2 birds compared to the other strains at both ages. Further processing at 19 wk showed that pectoralis major yield was higher for BUTA toms than the other strains and the primary reason for increased breast yield. Wing yield was lower and breast skin yield was higher for Hybrid toms at both ages compared to the other strains. Wing yield was lower for Hybrid Converter toms compared to BUTA Big 6 toms at 18 wk of age (16.7 kg body weight) in an earlier tom strain trial conducted under the same conditions (Roberson *et al.*, 2003). Thigh and drumstick yields were lower for BUTA toms than the other strains at 17 and 19 wk of age. Thigh yield was higher in Nicholas toms than Hybrid toms at 19 wk of age. Breast bone yield was higher for BUTA toms at 19 wk of age compared to the other two strains. The differences in carcass components between the BUTA T2 strain and the other

Table 4: Effect of commercial tom strain on color attributes (L*, a*, b*) of raw pectoralis major muscle at 19 wk of age

Parameter	Hybrid Converter	Nicholas 700	BUTA[1] T2	avg	SEM	trt, p<
L*	49.0	48.9	50.1	49.5	0.4	0.076
a*	16.8	16.1	16.1	16.3	0.2	0.077
b*	6.2[b]	6.7[a]	6.8[a]	6.7	0.1	0.008

[a-c]Means within a row with no common superscript differ significantly ($p < 0.05$). [1]British United Turkeys of America

two strains of commercial toms were consistent in this experiment regardless of marketing age or weight. Differences in carcass components at 16 and 18 wk of age were few and inconsistent in a previous study in which BUTA Big 6 toms were compared to the same competitor strains used in the current experiment (Roberson *et al.*, 2003).

There were no significant effects on lightness (L*) or redness (a*) of breast meat (Table 4). The average L* value was 49.5 in this experiment. Barbut (1996) reported that the average L value of turkey breast meat in a commercial facility was 48.5 and that a L value > 50 showed problems with pale, soft and exudative (PSE) meat. However, Owens *et al.* (2000) used an L value of 53 as a threshold to separate pale and normal turkey breast meat from a commercial processing plant. Yellowness (b*) was lower for Hybrid toms compared to the other two strains in this experiment. Roberson *et al.* (2003) previously reported that cooked pectoralis major muscle from Nicholas toms had less yellowness than other turkey strains.

The comparative growth rates of toms in this experiment would result in BUTA T2 turkeys reaching an 18 kg target body weight 3 d sooner than Nicholas 700 toms and 10 d sooner than Hybrid Converter toms. Due to a higher average daily gain and breast yield, BUTA T2 toms would be more profitable than Hybrid Converter toms in this experiment (assumes, in U.S. dollars, $0.32/kg retail tom price and $0.95/kg for breast meat). Hybrid Converter toms would be more profitable to raise than Nicholas 700 toms due to better livability. However, performance under field conditions may vary from the results in this experiment.

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References

Barbut, S., 1996. Estimation and detection of the PSE problem in young turkey breast meat. Can. J. Anim. Sci., 76: 455-457.

Brake, J., G.B. Havenstein, P.R. Ferket, D.V. Rives and F.G. Giesbrecht, 1995. Relationship of sex, strain, and body weights to carcass yield and offal production in turkeys. Poult. Sci., 74: 161-168.

Ferket, P.R., 2001. Turkey growth statistics: Growth rate continues to climb. Poult. USA , 2(Feb): 40-50.

Lilburn, M.S. and K.E. Nestor, 1991. Body weight and carcass development in different lines of turkeys. Poult. Sci., 70: 2223-2231.

Moran, E.T., Jr., L.M. Poste, P.R. Ferket and V. Agar, 1984. Response of large tom turkeys differing in growth characteristics to divergent feeding systems: Performance, carcass quality, and sensory evaluation. Poult. Sci., 63: 1778-1792.

National Research Council, 1994. Nutrient Requirements of Poultry. 9th revised edition. National Academy Press, Washington, DC.

Owens, C.M., E.M. Hirschler, S.R. McKee, R. Martinez-Dawson and A.R. Sams, 2000. The characterization and incidence of pale, soft, exudative turkey meat in a commercial plant. Poult. Sci., 79: 553-558.

Roberson, K.D., A.P. Rahn, R.J. Balander, M.W. Orth, D.M. Smith, B.L. Booren, A.M. Booren, W.N. Osburn and R.M. Fulton, 2003. Evaluation of the growth potential, carcass components and meat quality characteristics of three commercial strains of tom turkeys. J. Appl. Poult. Res., 12: 229-236.

SAS Institute, 2003. Release 8.2 Edition. SAS Institute Inc., Cary, NC.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics. McGraw-Hill Publishing Co., New York, NY.

Waldroup, P.W., J.A. England, A.L. Waldroup and N.B. Anthony, 1997. Response of two strains of Large White male turkeys to amino acid levels when diets are changed at three- or four-week intervals. Poult. Sci., 76: 1543-1555.

Warnick, R.E., 1988. Turkey research progress report. Utah Agri. Exp. Sta. Snow Field Sta. Res. Rep., 127.

[1]Cooper Hatchery, Inc., Oakwood, OH 45873. [2]Hamilton Farm Bureau, Hamilton, MI 49419
[3]Leco Nitrogen Analyzer, Leco Corp., St. Joseph, MI 49805. [4]Minolta Corporation, Ramsey, NJ 07446