Journal of Animal and Veterinary Advances 9 (10): 1485-1490, 2010
ISSN: 1680-5593

Comparison of Fast and Medium-Growing Broiler Genotypes Raised Indoors: Growth Performance, Slaughter Results and Carcass Parts

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Abstract: The aim of this research was to compare fast (Ross 308) and medium-growing (Hubbard ISA Red JA) broilers for growth performance and slaughter results under indoor conditions. In total 560 chicks from Fast (FG) and Medium-Growing (MG) genotypes were housed in 16 floor pens (12 chicks m^{-2}). Feed and water were offered *ad libitum* and the lighting period was 18 h day^{-2} after the first week. All birds were fed with starter diet (21.9% CP, 3020 kcal ME kg^{-1}) for the first 3 weeks and then grower diet (19.5% CP, 3127 kcal ME kg^{-1}) was used. Death, body weight and feed consumption were recorded. Chickens were slaughtered at 56 days of age. Slaughter losses, carcass, giblets, abdominal fat and carcass parts weight were determined. Sensory characteristics of whole raw carcasses were evaluated by 5 panellists with a 7-point scale. Mortality rates were compared by the Mann Whitney-U test and the others with the t-test. FGs had higher body weight gain and feed consumption than MGs during the fattening period ($p<0.001$). Mortality of MGs (2.78%) and FGs (2.43%) were similar. MGs showed higher head, feet + shanks, offal, giblets and fat pad percent ($p<0.05$). Hot carcass yields were 75.7 and 72.8% for FG and MG ($p<0.001$). FGs took higher values for raw carcass sensory traits as conformation, subcutaneous fatness and surface colour ($p<0.05$). Breast and breast meat yield were higher in FGs, however MGs showed higher means for legs, wings, neck and back percent. Taking into account the performance and slaughter results, MGs are disadvantaged compared to FGs.

Key words: Broiler, fast-growing, medium-growing, performance, slaughter results, carcass, yields abbreviations

INTRODUCTION

Alternative poultry production systems have met the sensitivities of the prosperous western public concerning animal welfare, environment conservation and sustainability and the demand for superior taste products. These systems have led to diversity of poultry production. For example in France, main systems of chicken meat production are standard, labelled and certified. Standard production uses Fast-Growing (FG) and high meat yield birds which are slaughtered at 6-7 weeks of age while label production uses Slow-Growing (SG) strains slaughtered at 12 weeks of age; the certified chicken is a crossbred of a standard and labelled chicken which has a Medium-Growth (MG) rate and is slaughtered at 8 or 9 weeks of age (Chartrin *et al*., 2005). The usage of slower-growing genotypes is one of the basic parts of alternative broiler production systems (Anonymous, 2000; Fanatico *et al*., 2005) raised the different broiler genotypes to typical market live weights and reported that a 2.5 kg slaughter weight was reached at 53 and 67 days of age for FG and MG genotypes, respectively however, the SG genotype achieved only 2.1 kg body weight at 77 days of age; SG and FG genotypes had the lowest and highest feed efficiencies in sequence. Despite the disadvantage in performance, broiler genotypes had a lower growing rate have some advantages with regard to animal welfare (Van Horne *et al*., 2004; Fanatico *et al*., 2008). In addition, it has assumed that the taste of slower growing chicken lines meat is more suitable for a gourmet market than FGs (Lewis *et al*., 1997; Castellini *et al*., 2002a).

Alternative systems, particularly organic and labelled have strict criteria, one of which is to limit the capacities of poultry-house and farm (Anonymous, 2000). This limitation led to an increase in the numbers of poultry farmers. In 2007, about 6000 farmers produced labelled poultry meat and eggs in France and Label Rouge traditional poultry accounted for 62% of whole chickens purchased (www.poultrylabelrouge.com). Westgren (1999) described this successful production style in France as a contra-industrial system.

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The commercial poultry sector has developed most successfully in the last 30-40 years in Turkey. While annual chicken meat production and consumption was 217,000 tonnes year^{-1} and 3.8 kg capita^{-1} in 1990, it reached about one million tonnes and 15 kg in 2007 (www.besd-bir.org). The fact that pork is not consumed for religious and cultural reasons and chronic problems with red meat production raises the importance of poultry production even further. According to Turkish Statistical Institute data (www.turkstat.gov.tr), the amount of red meat production is only half of the chicken meat production.

On the other hand, one of the characteristics of the Turkish poultry sector has been a lack of diversity for production systems and poultry species. For example, annual Turkey meat production has been fluctuated 30,000-50,000 tons in last decade (www.turkstat.gov.tr) and alternative production systems are recognised as absent. This study reports some results of a group project concerning alternative poultry production systems that could provide more chose for Turkish consumers who met nearly 60% of their total meat consumption needs with standard broiler chicken meat. This type of semi-extensive production systems may also help to create new employment for the 29.5% of the population who live in rural areas in Turkey (www.turkstat.gov.tr). As the usage of relatively slower growing genotypes is one of the main parts of alternative systems the present research aimed to compare the medium growing genotype which had recently been introduced in Turkey with a widely used standard FG broiler genotype for growth performance and slaughter results under indoor condition.

MATERIALS AND METHODS

A trial was conducted in the Research and Application Unit of the Agricultural Faculty, Akdeniz University. Cobb 308 was used for the FG genotype whereas the MG genotype was Hubbard ISA Red JA. The experiment lasted from December 2006-February 2007 in the windowed experimental house. About 280 chicks (male and female) from each genotype were obtained from a local hatchery (Ege-tav, Turkey) and were placed in floor pens of 195×150 cm each one contained 35 chicks (12 chicks m^{-2}). Genotype groups were randomly allocated to 16 pens had wood shaving litter, nipple drinker and trough feeder. Additional heating was applied and standard brooding management was followed in the 3 weeks. Lighting periods were 24 h during the first day, 22 h day^{-1} between 2nd and 6th days and than 18 h day^{-1} (Ipek *et al*., 2009). Feed and water were provided *ad-libitum*. All birds were fed with a starter diet (21.9% CP and 3020 kcal ME kg^{-1}) for the first three weeks and a grower diet (19.5% CP and 3127 kcal kg^{-1} ME) was used in the later period. The diets were devoid of animal by-products and antibiotics and a natural feed additive (Orego-stim®) was joined to the grower diet (0.05%). Chickens were vaccinated against coccidiosis on the 1st day and newcastle and infectious bursal (Gumboro) diseases at 21 days.

During the experiment, deaths were recorded daily. The individual live weights and feed consumption of each pen were determined weekly. At the end of the trial (56 days), the 30 broilers from each genotype were selected randomly for slaughter. They were weighed before and after the overnight feed withdrawal (about 10 h) and slaughtered. Scalding in hot water and manual evisceration were applied after blooding. During these procedures necessary measurements were done and recorded for calculating slaughter loss yields (head, shank + claws, blood + feathers and offal (total non edible inner organs and their contents)). In addition, giblets weights were measured and gizzards contents added to offal.

After evisceration, the carcasses were immersed in cold water and packed in polythene bags after draining. The bagged carcasses were stored at +4°C for about 20 h. The following day, 5 panellists evaluated all the whole raw carcasses for sensory characteristics such as conformation, subcutaneous fatness and surface colour. This analytical descriptive test performed with a scale (1-7), a higher note signifying superior quality (Zeelender *et al*., 1995).

Abdominal fat was removed by hand and recorded and the weight of fat surrounding the gizzard was added to abdominal fat. Then, half of the carcasses were randomly selected and cut to parts as breast, legs (consisted of gluteus muscle), wings, back and neck. In the later stages, the breast meat was separated and weighed.

The shrink because of feed withdrawal was expressed relative to body weight before fasting whereas the slaughter losses, carcass, giblets and abdominal fat weights were expressed as a percentage of body weight after feed withdrawal. On the other hand, carcass parts and breast meat were evaluated as a rationing to cold carcass weight. Mortality rates of two genotypes were compared by the Mann-Whitney U test and the other data were matched with a t-test. Statistical analysis was performed by using the software package SPSS for Windows (SPSS. Inc., Chicago, IL, USA).

RESULTS AND DISCUSSION

Growth performance: As shown in Fig. 1, MG broilers showed lower daily weight gain than FG. Weight gains of

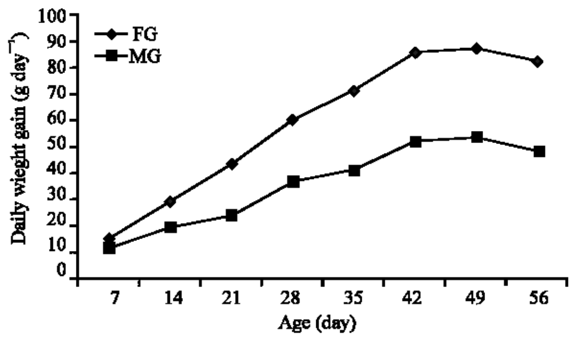

Fig. 1: Change of daily weight gain of the FG and MG broilers up to 56 days of age

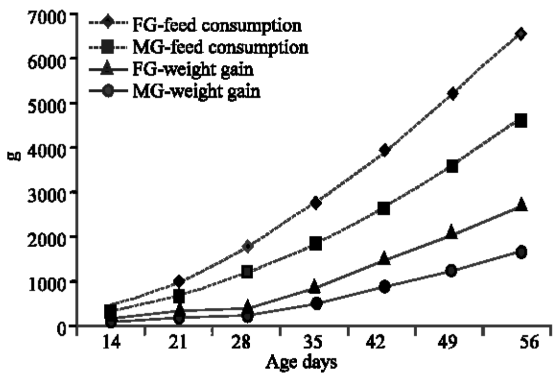

Fig. 2: Average cumulative body weight and feed consumption of the FG and MG broilers up to 56 days of age

two genotypes increased until 6 weeks of age remained at the same level at the 7th week and than slightly declined.

However, Karaoglu *et al*. (2005) reported that weight gain of standard FG broiler increased dramatically until 6 weeks of age and than quickly declined but Santos *et al*. (2005) raised MG and SG broilers also determined that growth rates of genotypes decreased slightly.

Average cumulative body weight and feed consumption are given as shown in Fig. 2. FG birds had a higher body weight and feed consumption than MGs during all of the fattening period. FGs reached the same body weight 2 weeks earlier than MGs. Feed efficiency of FG birds was determined 1.99±0.01 whereas 2.29±0.07 was for MG (mean±SEM, $p<0.01$) in this research. Many researchers also concluded that FG genotype had higher body weight and feed consumption and better feed utilization than MG (Lewis *et al*., 1997; Van Horne *et al*., 2004; Castellini *et al*., 2002b). Lewis *et al*. (1997) determined that the feed efficiency of

Table 1: Effects of genotype on the slaughter results

Factors	FG (n = 30)	MG (n = 30)	p-value
Slaughter weight (g)			
Before feed withdrawal[1]	3422.4±60.0[2]	2204.1±46.7	0.000
After feed withdrawal[1]	3311.7±58.6	2112.8±43.7	0.000
Shrink[3]			
Gram	110.7±5.60	91.2±8.50	0.123
Percentage	3.2±0.20	4.1±0.40	0.009
Head			
Gram	76.8±2.10	66.1±1.80	0.001
Percentage	2.3±0.00	3.1±0.00	0.000
Feet + shanks			
Gram	107.5±4.20	78.0±2.50	0.000
Percentage	3.2±0.10	3.7±0.10	0.000
Blood + feathers			
Gram	348.5±19.4	220.8±20.9	0.001
Prcentage	10.4±0.40	10.5±0.90	0.222
Offals[6]			
Gram	164.6±3.40	123.6±2.90	0.000
Prcentage	5.0±0.10	5.9±0.10	0.000
Hot carcass[7]			
Gram	2505.0±42.6	1532.1±30.3	0.000
Prcentage	75.7±0.50	72.8±1.20	0.000
Giblets[8]			
Gram	109.3±2.40	82.8±2.00	0.000
Prcentage	3.3±0.10	3.9±0.10	0.000
Fat pad[9]			
Gram	40.8±3.10	29.7±2.00	0.006
Percentage	1.6±0.10	2.0±0.10	0.044

[1]About 10 h. [2]Mean ± SEM. [3]The difference between the slaughter weights determined before and after feed withdrawal. [4]Relative to slaughter weight before feed withdrawal. [5]Relative to slaughter weight after feed withdrawal. [6]All non edible inner organs (without giblets) and contents. [7]Included neck and fat pad, excluded giblets. [8]Liver, hearth and gizzard (included membrane, excluded contents). [9]Included gizzard fat

FG and MG groups were 2.00 and 2.11, respectively. Fanatico *et al*. (2005) who raised several broiler genotypes had a different growth rate to the same slaughter weights (2.5 kg) concluded that FG and MG birds reached that weight on the 53rd and 67th days and their feed efficiency ratios were 2.13 and 2.68, respectively ($p<0.05$).

Despite the fact that some researchers (Lewis *et al*., 1997; Van Horne *et al*., 2004) reported the FGs had a higher mortality rate, FG broilers (2.43±1.37%) showed a similar mortality rate with Mgs (2.78±1.37%). In line with the findings, Fanatico *et al*. (2005) reported that mortality rates were below 5% and the difference among genotypes was too small.

Slaughter results: The slaughter data and statistical analyses are shown in Table 1. The body weights after the 56 days fattening period were determined to be 3422.4 g for FGs and 2204.1 g for MGs, the difference between genotypes was found to be significant ($p<0.001$). FG and MG birds lost 110.7 and 91.2 g in body weight during feed withdrawal period about 10 h. The shrinks were 3.2 and 4.1% for FG and SG, respectively and were affected by genotype ($p<0.01$, Table 1).

At the end of the same withdrawal period, MGs having a lower body weight showed a higher percentage of weight less than FGs which can be accepted as a reasonable outcome. Zuidhof *et al.* (2004) reported that 4 and 16 h feed withdrawals had resulted in 2.1 and 3.3% shrinkage. In the other research (Contreras-Castillo *et al*., 2007), the body weight loss was determined to be 1.3-5.3% at the end of the 3-18 h fasting for slaughter. These notices have been taken into account the findings about shrink rate can be accepted as slightly higher.

FG broilers had greater absolute weight means than MGs for head, feet, shanks, blood + feathers and offal as shown in Table 1 ($p<0.001$). Genotypes showed a similar percent for blood and feathers but for the other slaughter losses ratio, MG group had higher means ($p<0.001$, Table 1). Castellini *et al.* (2002b) concluded that both empty gastrointestinal tract and content weight percents were higher for MG than FG. The researcher found that head, feet + shanks, blood + feathers and offal were 2.3, 3.2, 10.4 and 5.0%, respectively for FGs. Karaoglu *et al.* (2005) determined that these ratios as 3.1, 4.4, 8.8 and 4.3% for standard broilers.

Hot carcass weight and yield are significantly affected by genotype (Table 1, $p<0.001$), the means of these criteria for FGs and MGs were 2505.0 and 1532.1 g and 75.7 and 72.8%, respectively. Karaoglu *et al.* (2005) reported carcass yield was 75.8% for the standard broiler. Grashorn (2006) concluded that FG broilers had shown 4% higher carcass yield than SGs. According to the findings, the difference between genotypes carcass yield is 3.8%. In other research, Fanatico *et al.* (2005) found that FG broilers reached slaughter weight 14 days earlier showed a higher ($p<0.05$) carcass yield than Mgs.

As shown in Table 1, FGs had higher fat pad weight (40.8 vs. 29.7 g) and lower ratio (1.6 vs. 2.0%) relative to body weight and these differences between genotypes were significant ($p<0.01$ and $p<0.05$, respectively). It is possible to find conflicting results on this subject. In contrast to the results both Lewis *et al.* (1997) applied 48 days fattening and Castellini *et al.* (2002b) slaughtered broilers at the 82nd day of age reported that FGs had higher abdominal fat ratio than MGs ($p<0.05$ for both). On the other hand, Grashorn (2006) observed no significant difference for fat pad yield between Mgs and SGs. Santos *et al.* (2004) aimed to slaughter different genotypes at 2.5 kg body weight reported FG genotype showed lower abdominal fat pad percentage than MG. Fat deposition are affected many factors like age, genotype, sex, feed nutrition, etc. When they considered that the lines selected for low fat deposition have a more favourable feed conversion than lines selected for the opposite characteristic (Leenstra, 1986), researchers concluded that the result about fat pad ratio was reasonable. Giblet weight was determined as being higher for FGs whereas MGs had higher relative giblet weight (Table 1, $p<0.001$, $p<0.001$). Karaoglu *et al.* (2005) reported relative giblet weight as 3.9% for FG standard broiler and calculated that ratio was 3.3 and 3.9% for FG and MG birds (Table 1).

Table 2: Effects of genotype on sensory traits 1 of raw carcasses

Traits	FG (n = 30)	MG (n = 30)	p-value
Conformation	5.8±0.2[2]	3.0±0.2	0.000
Subcutaneous fattiness	5.5±0.1	5.2±0.1	0.010
Colour	5.7±0.1	4.4±0.1	0.000

[1]Seven ranked scale was used, 1 was the l owest and 7 was the highest. [2]Mean±SEM

Table 3: Effects of genotype on the carcass and parts yield

Carrcass parts	FG (n = 15)	MG (n = 15)	p-value
Cold carcass[2]			
Gram	2531.3±42.6[1]	1542.7±30.7	0.000
Percentage	76.5±0.40	72.4±0.90	0.023
Breast			
Gram	815.9±16.1	380.4±7.80	0.000
Percentage	32.3±0.40	24.7±0.30	0.000
Legs			
Gram	768.4±17.5	499.8±11.3	0.000
Percentage	30.3±0.30	32.4±0.20	0.000
Wings			
Gram	300.9±5.6	205.0±3.90	0.000
Percentage	11.9±0.10	13.3±0.10	0.000
Neck			
Gram	170.6±4.70	135.9±4.00	0.000
Percentage	6.7±0.10	8.8±0.10	0.000
Back			
Gram	471.6±9.30	307.7±6.70	0.000
Percentage	18.6±0.20	20.0±0.30	0.000
Breast meat			
Gram	648.1±20.6	288.5±12.1	0.000
Percentage	25.6±0.50	18.7±0.30	0.000

[1]Mean±SEM. [2]Included neck excluded giblets and fat pad. Relative to slaughter weight after feed withdrawal. [4]Relative to cold carcass weight

The outer appearance of the fresh broiler body is the main factor affecting consumers. As shown in Table 2, FG broilers showed higher conformation ($p<0.001$), subcutaneous fattiness ($p = 0.01$) and surface colour ($p<0.001$) values. Average estimations for conformation were 5.8 and 3.0 for FG and HG (Table 2). Zeelender *et al.* (1995) used a scale from 1-7 as determined the average conformation values as 5.60 for FG, although it was 4.79 for SG local genotype. They also reported that local genotype had showed higher means for surface colour (5.71 vs. 5.39, $p<0.05$). In contrast, the panellists of the present research gave also a higher value to FGs (5.5 vs. 5.2) for colour (Table 2). The fact that FGs had a higher average than MGs for subcutaneous fattiness agrees with results reported by Zeelender *et al.* (1995).

Carcass parts: Cold carcass weights were 2531.3 g for FG and 1542.7 g for MG (Table 3) and the genotype effect was significant ($p<0.001$). As shown in Table 3, FG birds showed higher breast, legs, wings, back and neck weights than MGs ($p<0.001$). In consideration of relative weights of parts to cold carcass weight FGs showed a higher average for breast only whereas MGs had higher values for other parts ($p<0.001$, Table 3). Lewis *et al.* (1997) and Fanatico *et al.* (2005) also reported MG had lower breast and higher wings percentages. Nevertheless in this present research that MG show higher leg yields ($p<0.001$), same researchers (Lewis *et al.*, 1997; Fanatico *et al.*, 2005) concluded that MG birds show similar relative weights with FG for leg yield. According to Santos *et al.* (2004), FG broilers had a higher thigh yield than MGs but two genotypes were similar for total leg yield. In another research, Fanatico *et al.* (2008) reported SGs showed lower breast, higher wing and leg yield than Fgs. Breast meat is the most valuable part of the carcass. As shown in Table 3, MG broilers had lower breast meat yield than FGs (18.7 and 25.6%, respectively, $p<0.001$). Grashorn (2006) determined the breast meat yield as 18.1 and 26.9% for SG and FG. Fanatico *et al.* (2005) also reported a similar difference between genotypes ($p<0.05$).

CONCLUSION

In terms of live weight gain and feed efficiency, MG broilers were clearly disadvantaged compared to FGs. However, the weight gains of genotypes did not dramatically decrease in the last weeks of fattening, suggesting that these genotypes must be compared over a longer fattening period. MGs also had a deficiency for slaughter results and valuable carcass parts yield. To decide about the usability of the slower-growing broiler lines, it seems that other dimensions of the subject like the sensory qualities of meat and animal welfare should be included in the comparison. Sensitivity to these issues may vary from country to country.

ACKNOWLEDGEMENTS

This research was funded by The Scientific and Technological Research Council of Turkey (Project no: 105 O 432). Researcher would like to express the sincere appreciation to Ege-Tav (Turkey) company for supplying chicks and Polimed (Turkey) for feed additives and vaccines. We also thank Dr. M.Z. Firat and Dr. P.G.A. Glover for the edition of the manuscript.

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