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EFFECT OF AGE, SEX AND STRAIN ON GROWTH, BODY COMPOSITION AND CARCASS CHARACTERISTICS OF DUAL PURPOSE TYPE CHICKEN

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ABSTRACT

Despite the significant market position of dual purpose and slower growing broiler chickens in Europe and Asia, only few studies exist investigating their growth, body composition and slaughter characteristics during the rearing period. The objective of this study was to detect age, sex and genotypic differences of the previously mentioned traits. Two trials were carried out under standard commercial conditions. In the first trial, a dual purpose hybrid (TH) and a coloured broiler (SR) in the second trial 3 different genotypes were tested. In each test 110 male and 129 female chicks were housed to a pen. In the first trial 3 replicate pens in the second trial 4 replicate pens per strain and sex consisted the experimental stock. In both trials chicks were weighted individually at 4, 6, 8, 10, 12 weeks of age. From each genotype and sex, 20 birds were examined by computer tomography at the same time when body weights were measured. At 70 and 84 day of age, 20 birds/genotype/sex were slaughtered and dissected individually. TH genotype had higher leg ratio, lower fatness and better FCR, while SR birds had better breast and slaughter yield ($p<0.05$). Whatever the age, females developed higher breast yield, but had worse FCR and more fat than cocks in both trials. The *in vivo* CT, growth and carcass data showed significant genotypic, sex and strain effects within age groups. Dual purpose genotypes were characterised by lower breast yield, higher thigh ratio and lower fatness than coloured broilers.

KEYWORDS: chicken, growth, tissue development, slaughter traits

INTRODUCTION

Dual purpose chicken genotypes are increasingly popular in some regions of Eastern and Middle Europe and Asia, where they play an important social role among farmers and have a positive impact on maintaining rural society and traditional form of agriculture as well as gratify certain local traditions. Their meat and high number of laid eggs provide enhanced income for small scale family farms. The breeding of these chickens in Hungary is characterized with crossbreeding between colour feathered, meat type cocks and brown layer dam line selected for egg production. However, balance between these two traits can easily capsize when certain marketing needs require higher body weight. Selection towards increased meat yield will result in less eggs and higher abdominal fat because the genetic merits of these traits are negatively correlated (Leenstra and Pit, 1988). It is well known, that higher abdominal and

subcutaneous fat occurs among slow-growing genotypes to a different extent, which needs to be monitored by breeding companies to avoid strains that are more prone to fattening (Ristic *et al*., 2008). Differentially selected lines or selection based on improved FCR could solve these problems. On the other hand, fat stored intramuscularly is highly regarded by consumers looking for quality and tasty meat products (Zerehdaran *et al*., 2003). The objective of the current study was to define certain characteristics related to gender and age in chickens bred for dual purpose, with the use of computer tomography. Furthermore, we were aimed to ascertain how a new sire line alters the muscle development and fat deposition of its offspring.

MATERIAL AND METHODS

Animals and data collection

In 2 test series different strains were kept and compared in the Poultry Test Station of the Kaposvar University. In both cases, birds were reared in a closed building, in pens (9.2 m^2), separated by sex and genotypes (110 cocks or 129 pullets/ pen). Chickens were *ad libitum*-fed with commercial diet specially designed for slower growing birds (Table 1.).

Test A involved 2 genotypes; a nationally bred dual purpose hybrid, TETRA-H (TH) and a well known coloured feather broiler, Shaver Redbro (SR), with 1436 chicks in total. Test B included 2868 birds of 3 genotypes; old sire line (HH), used in a breeding program of TETRA-H, a new sire line (EE) selected for improving the final liveweight and meat production of TETRA-H, and their F1. Fattening performance (liveweight, FCR) was recorded every second week till the age of 84 days. Comparison of final slaughter weights was performed at 70 and 84 d. Statistical evaluation was carried out with SAS software (SAS 9.1), using the GLM model. For all analysis, $p < 0.05$ considered significant.

In vivo body composition analysis and slaughter performance

Examinations were carried out at the Institute of Diagnostic Imaging and Radiation Oncology of the Kaposvar University, by-weekly, between 4 and 12 weeks of age. Throughout the trial, the same, individually tagged birds were used for all examinations (n=20 of each gender and genotype). The CT measurements consisted of overlapping 8 mm thick slices covering the whole body (Siemens Somatom Emotion 6 Multislice). Using the images obtained so called muscle and fat indices were calculated (ratio of number of pixels with x-ray density values of muscle or fat / the number of pixels with density values of muscle, water and fat, i.e. the range between -200 to +200 on the Hounsfield – scale). In both trials comparison of tissue development changes were performed. On the 70 and 84 days of age 20 birds of each group were killed. Carcasses were air chilled in a cold room at 5° C for 3 hours, then their weights, abdominal fat, breast and leg muscle were measured individually.

RESULTS AND DISCUSSION

Table 1 - Composition of experimental diets

	Starter (0-19 days)	Grower (20-49 days)	Finisher (50-83 days)
Crude Protein %	18.8	18.0	16.4
Crude Fat %	4.0	5.2	6.3
ME MJ/kg	12.1	13.1	12.2
Calcium g/kg	8.2	8.3	8.2
Phosphorus g/kg	7.0	6.9	6.6

Growth performance and carcass traits

The broilers of SR line were heavier and reached higher slaughter yield in both sexes. On the other hand, SR feed conversion was worse (2.4 – 2.53 and 2.88 - 3.01 kg/kg by 70 and 84 d, respectively),

Table 2 - Carcass data.

Traits	Sex	Genotype - Test A			
		Shaver Redbro	TETRA-H	Shaver Redbro	TETRA-H
		70 days		84 days	
Liveweight (g)	M	3504 [a]	2518 [b]	3930 [a]	2902 [b]
	F	2695 [b]	1907 [c]	2930 [b]	2215 [c]
Slaughter yield (%)	M	68.2 [a]	65.2 [b]	70.9 [a]	67.9 [b]
	F	68.4 [b]	65.7 [c]	68.0 [b]	67.5 [c]

a-c = means within a trait at a certain age lacking a common superscript differ ($p<0.05$), M = male, F = female

than in TH (2.27 – 2.38 and 2.74 – 3.05 kg/kg by 70 and 84 d, respectively). Pullets in both genotypes converted feed less effectively, than cocks ($p<0.05$). Whatever the slaughter age, SR chickens exhibited higher breast ratios than TH chickens in both sexes. TH males had a significantly higher leg ratio, which is well known characteristic of slow-growing genotypes (Ristic, 2008). TH pullets developed higher breast yield than TH cocks, whatever the slaughter age was. Whatever the age, differences in abdominal fat remained significant between SR and TH, but interestingly SR males tripled their abdominal fat pad in 14 days, while TH males only doubled it. Pullets, in general were fattier than cocks, which could be the result of the greater impact of hormones for fatness in females (Le Bihan-Duval *et al*., 1998)

New cock line reached the highest liveweight, and slaughter yield at 84 d. It was noteworthy, that progeny of the new cock line (EE) in both sexes reached the highest slaughter yield at 70th days of age, indicating the most economical time of slaughtering. FCR was worse in pullets of the old cock line (HH), with 3.24 and 3.89 kg/kg by the 70th and 84th d, respectively. Meanwhile, the improved sire line (EE) converted feed the most effectively with 2.36 and 2.98 kg/kg on 70th and 84th days, respectively and managed to inherit this favourable genetic trait to its offspring (2.53-3.02 kg/kg). Whatever the slaughter age or genotype, females had poorer FCR. Breast and leg ratio of F1 males were similar to HH ($p>0.05$), while breast yield of EE males was significantly better ($p<0.05$). No differences were found in breast yield between F1 and EE females by comparison with HH pullets at 84d. HH cocks had the lowest percentage abdominal fat (0.63 and 0.77 %), followed by F1 (0.79% on 70d) and EE line (0.88 and 1.34%) on 70 and 84 d, respectively. Again, females of EE line deposited significantly more fat than any other lines or sexes by the 70th d; however this was equalized among the other lines by 84th days of age.

Body Composition

Development of muscle tissue was increasing in all sexes and genotypes with various intensity up to the 6th weeks of age, than its rapidly decreased in SR and EE genotypes. This phenomenon was more intense in males. HH cocks have continued to develop muscle tissue up to the 8th weeks of age. Muscle index of F1 females was the

Table 3 - Carcass data.

Traits	Sex	Genotype - Test B					
		EE	F1	HH	EE	F1	HH
		70 days			84 days		
Liveweight (g)	M	3923^{a}	3154^{b}	2662^{c}	4106^{a}	3512^{b}	2918^{c}
	F	2987^{d}	2372^{e}	1907^{f}	3143^{d}	2594^{e}	2188^{f}
Slaughter yield (%)	M	66.7^{a}	67.3^{b}	65.9^{c}	70.3^{a}	67.2^{b}	66.1^{c}
	F	64.9^{d}	67.1^{b}	64.1^{d}	68.7^{d}	68.2^{d}	65.3^{e}

a-f = means within a trait at a certain age lacking a common superscript differ ($P<0.05$), M = male, F = female.

highest amongst pullets until the 6th weeks of age. Fat index was higher in pullets during the whole experimental period (FI = 31.2 – 36.9 and 27.6 – 32.6 in females and males, respectively). Within, EE and F1 pullets deposited more fat from the 6th weeks of age onwards, while HH pullets remained less fatty throughout. Fat index of males of all genotypes remained different ($P < 0.05$) till the end of the trial and its ratio was changing in proportion with the muscle tissue. EE pullets had the highest fat index, which deteriorated by age. Muscle/fat ratio was more favourable in F1 males at 84 days of age than in pullets.

CONCLUSION

Dual purpose chickens slaughtered at the same age as colour feathered broilers characterised by higher sexual dimorphism on body weight, higher leg ratio and lower fatness. Muscle tissue development reached its maximum around the 6th weeks of age, then its diminished variously depending on line and sex. Females started to store fat from 6th weeks, while males only from the 8th weeks of age. Offspring (F1) of our new sire line reached the highest slaughter yield at 70th days of age in Test B and showed improvement in FCR and muscle/ fat ratio in comparison with the old cock line (HH). Due to the positive impact of the new sire line, carcass weight, slaughter and breast yield of the offspring in both genders has increased significantly.

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