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THE EFFECT OF GENOTYPE OF BROILER CHICKENS ON CARCASS QUALITY IN EXTENSIVE REARING SYSTEM

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Research was carried out on chickens of four genotypes: two slow-growing genotypes, Master Gris (MG) and Farm Q (FQ), one fast-growing, Hubbard Classic (HC) and one medium-growing Red Bro (RB). To the age of 3 weeks, chickens were reared according to all technological norms for intensive production. After that period, chickens were moved and fattening in extensive conditions resumed, using unlimited free range. The significance of genotype on body mass was established. The greatest final body mass was established in chickens of the Master Gris genotype (1983 g) and the lowest in Farm Q (1371 g). Fast-growing chickens of genotype Hubbard Classic at the age of 84 days had body mass at the level of medium-growing Red Bro genotype at the age of 91 days (1730 g, and 1759 g, respectively). In accordance to the established body mass, slaughter yields of Farm Q broilers were significantly the lowest. Also, chickens of this genotype also had significantly ($p<0.05$) lower share of abdominal fat compared to other genotypes. Chickens of Master Gris and Red Bro genotypes had significantly greater shank length (22.57 and 21.01 g/mm, respectively), whereas in fast-growing genotype Hubbard Classic a significantly greater breast angle (90.15 degrees) was determined. Accordingly, share of breast (15.90 %), as well as share of breast meat (10.11 %) was significantly greater in carcasses of Hubbard Classic chickens.

Key words: genotype, extensive system, carcass quality

INTRODUCTION

In modern intensive broiler production commercial body mass is reached at 42 days of age with high yield of carcass and share of breast meat which are considerably under the influence of genotype, nutrition, adequate management, etc. In this way, the market is supplied with great quantities of relatively inexpensive food. However, fast growth of chickens represents concerns related to their welfare, especially in regard to the frequency of metabolic disorders and

diseases of the skeleton. Also, selection on fast growth and high yields has effects on sensory and functional qualities of meat (Le Bihan-Duval *et al.*, 2003). Consumers increasingly demand more natural rearing conditions which include use of fenced and grass ranges, but also rearing of slow-growing hybrids of broiler chickens. This consumer attitude represents a possibility for market improvement (conventional, free-range, and organic), as well as realization of premiums for chicken meat deriving from specific production systems.

It is known that slow-growing broilers differ in carcass yield and meat quality from fast-growing broilers (Berri, 2000; Havenstein *et al*., 2003). While investigating the slaughter characteristics of slow-growing broilers in conditions of organic production, Ristić and Damme (2002) established lower body masses, but improved meat quality in relation to conventional production. Similar results are stated by Grashorn and Serini (2006). Owens *et al*. (2006) established by comparing slow-growing with commercial broiler chickens in intensive and semi-intensive rearing system a significantly higher body mass and a higher relative share of breast meat in commercial hybrids in both rearing systems. Studies of Grashorn and Clostermann (2002), slow-growing genotypes of Isa-Hubbard broilers took 10-32 days longer in fattening to achieve the same body mass which broiler chickens of Ross genotype realize in 42 days. Also, chickens of Ross genotype had better slaughter yields compared to slow-growing broilers ISA 657 reared in the extensive system. Milošević *et al.* (2003) described no significant differences in slaughter yields between chickens of Ross genotype reared conventionally and on limited free range.

Research was carried out in order to compare slow-growing genotypes of chickens but also to obtain results for fast-growing genotypes in extensive rearing conditions, in regard to carcass quality, yield, conformation and shares of major carcass parts.

MATERIALS AND METHODS

The experiment was carried out on four genotypes of chickens of Hubbard-ISA; two slow-growing: Master Gris (MG) and Farm Q (FQ), one fast-growing: Hubbard Classic (HC) and one medium-growing Red Bro (RB). Number of chickens included in this trial was 100 birds per genotype. For the purpose of obtaining more unified final body masses of chickens of fast-growing and slow-growing genotypes, i.e. more precise comparison of the carcass quality properties, chickens of the Hubbard Classic genotype were included in the trial after 7 days (Fanatico *et al*., 2007). Chickens were reared up to the age of 3 weeks according to all technological norms of intensive production, in closed facilities without free range, with controlled environmental conditions and balanced nutrition. After this period, chickens were moved and rearing in so called extensive conditions resumed, with the use of unlimited free range. Chickens were provided with housing during night in a closed facility with perches and without a controlled environment. During the day chickens were mainly outdoors. Nutrition and water supply were within the facility, but there was one part of the free range equipped with feeders and waterers. Nutrition was based on a coarsely ground cereal

mixture (maize, wheat, oats) with vitamin-mineral supplement and feed that chickens found on the free range. At the end of the fattening period, at the age of 92 and 84 days, brojlers were weighed individually and a random sample of chickens (10 per sex and genotype) was taken for investigation of slaughter traits. Yields were established (conventional processing, Ready to roast and Ready to grill); share of abdominal fat; carcass conformation, based on measured absolute and subsequently calculated index values of shank length (BM/SL), keel length (BM/KL), breast depth (BM/BD), thigh girth (BM/TG) and breast angle (BA) as single measure which is not under the influence of body mass (Pavlovski and Mašić, 1983). In order to separate breasts, thighs and drumsticks, carcasses were cut according to Regulation on quality of poultry (1981) and subsequently breast, thigh and drumstick meat separated. After their mass was established, shares were determined in relation to body mass of bird prior to slaughtering.

Statistical analysis of obtained data was done using computer program Stat. Soft, Inc. (2003) STATISTICA (data analysis software system), version 6.

RESULTS AND DISCUSION

Results presented in Table 1 indicate a significant effect of genotype on final body mass, yield, as well as shares of abdominal fat. The greatest final body mass was achieved by chickens of genotype Master Gris (1983 g) and the lowest by chickens Farm Q (1371 g). Fast-growing chickens of genotype Hubbard Classic at the age of 84 days had body mass at the level of medium-growing Red Bro genotype at the age of 91 days (1730 g, and 1759 g, respectively). From the aspect of relative yield of carcass and slaughter yields (conventional processing, Ready to roast, Ready to grill) no statistically significant falling behind of these two genotypes (Hubbard Classic and Red Bro) in relation to Master Gris was registered. According to the determined body mass, slaughter yields of chickens Farm Q were significantly the lowest. Also, chickens of this genotype had considerably ($p<0.05$) a lower share of abdominal fat (1.46 %) compared to other genotypes.

Table 1. Slaughter traits of chickens of investigated genotypes

Traits	Genotype			
	MG	RB	FQ	HC
Body mass, g	1983.0±183.79^{a}	1759.0±174.05^{b}	1371.0±174.90^{c}	1730.0±201.00^{b}
Conventional processing, %	83.68 ± 2.07 ^{a}	84.29 ± 2.99 ^{a}	79.40 ± 1.91^{b}	83.58 ± 3.69 ^{a}
Ready to roast, %	77.04 ± 1.91^{a}	77.39 ± 2.42 ^{a}	72.42 ± 2.15 ^{b}	76.69 ± 3.35 ^{a}
Ready to grill, %	66.23 ± 2.20 ^{a}	66.43 ± 2.49 ^{a}	62.56 ± 2.42 ^{b}	66.27 ± 2.85 ^{a}
Abdominal fat, %	3.16 ±1.05 ^{a}	2.71 ± 1.03 ^{a}	1.46 ± 0.98 ^{b}	2.36 ± 0.88 ^{a}

Means and standard deviation
a-c different letters in each row indicate statistical significance at the level of 5%

Škrbić *et al.* (2007) state slightly lower values of yields (83.45%, 75.81%, 65.73%) and shares of abdominal fat (2.37%) in carcasses of Red Bro chickens reared on free range to 84 days of age, which can be explained by the effect of chicken age (Bilgili *et al.*, 1992; Santos *et al*., 2004). For the same reason, i.e. shorter fattening period for chickens of Hubbard Classic genotype, a disagreement with published research results of Van Horne *et al*. (2004), Fanatico *et al*. (2005), Owens *et al.* (2006) was observed, since these authors concluded a significantly higher increase of body mass of chickens of fast-growing genotypes compared to slow-growing chickens in the free range system. Based on the obtained data a clearly differentiated genetic potential for growth of investigated slow-growing genotypes can be concluded. Obtained differences are probably the consequence of different adjustments of certain genotypes to applied rearing conditions (nutrition, management). Sosnowka-Czajka *et al.* (2006) report about the possibility for rearing of commercial hybrids in the free range system, but only if hybrids which are more resistant to variable environmental conditions are selected. According to their ranking, Hubbard broilers were second behind Cobb and ahead of Ross.

Index values of conformation measures of chicken carcasses of investigated genotypes are presented in Table 2.

Table 2. Index values (g/mm) of conformation measures of chickens of investigated genotypes

Conformation measure	Genotype			
	MG	RB	FQ	HC
BM/SL	22.57 ± 2.07 ^{a}	21.01 ± 1.71 ^{ab}	17.04 ± 1.67 ^{c}	20.68 ± 2.29 ^{b}
BM/KL	19.41 ± 1.61 ^{a}	17.28 ± 1.38 ^{b}	14.80 ± 1.40 ^{c}	17.12 ± 1.64 ^{b}
BM/BD	19.33 ± 1.58 ^{a}	17.56 ± 1.34 ^{b}	14.82 ± 1.27 ^{c}	17.44 ± 1.51 ^{b}
BA, degrees	83.05 ± 7.98 ^{b}	82.40 ± 7.06 ^{b}	73.85 ± 7.75 ^{c}	90.15 ± 6.12 ^{a}
BM/BG	15.27 ± 0.75 ^{a}	14.37 ± 1.01 ^{b}	12.24 ± 0.92 ^{c}	13.72 ± 1.20 ^{b}

Means and standard deviation
a-c different letters in each row indicate statistical significance at the level of 5%

The worst carcass conformation ($p<0.05$), expressed by all conformation measures, established in chickens of genotype Farm Q, is the consequence of a significantly lower final body mass. Based on established values for shank length, used as indicator of the length of tubular bones, and as well as breast angle, which is indicator of the development of breast musculature, it is possible to determine differences between slow-growing and fast-growing genotypes. Chickens of genotypes Master Gris and Red Bro had significantly greater shank length (22.57 and 21.01 g/mm, respectively) as a result of selection directed towards better adjustment to conditions in extensive rearing systems. Fast-growing genotype Hubbard Classic selectioned towards higher yield of breast meat, a significantly greater breast angle was established (90.15 degrees), expressed also in

extensive rearing conditions. Other investigated conformation measures were significantly higher on carcasses deriving from Master Gris chickens, whereas between genotypes Red Bro and Hubbard Classic, no significant statistical differences were established.

Data relating to the share of breast, thighs with drumsticks, as well as share of meat from these carcass parts, are presented in Table 3.

Table 3. Shares of major carcass parts (% BM)

Share, % BM	Genotype			
	MG	RB	FQ	HC
Breasts	14.57 ± 1.36 ^{b}	14.91 ± 0.89 ^{ab}	12.58 ± 1.75 ^{c}	15.90 ± 1.13 ^{a}
Breast meat	8.60 ± 1.03 ^{b}	9.07 ± 1.53 ^{b}	8.09 ± 0.95 ^{b}	10.11 ± 1.33 ^{a}
Thigh with drumstick	22.45 ± 1.62 ^{ns}	22.38 ± 1.48 ^{ns}	21.36 ± 0.91 ^{ns}	21.51 ± 3.81 ^{ns}
Meat from thigh with drumstick	12.77 ± 1.13 ^{ns}	13.11 ± 1.53 ^{ns}	13.06 ± 1.34 ^{ns}	13.23 ± 0.83 ^{ns}

Means and standard deviation
a-c different letters in each rows indicate statistical significance at the level of 5%
ns – non-significance of differences, $p>0.05$

According to the established conformation measures which indicate better development of breasts in Hubbard Classic genotype, a significantly higher share of breasts prior to slaughtering was established (15.90 %) compared to slow-growing chickens (14.57%; 12.58%). Also, share of breast meat was significantly higher in genotype Hubbard Classic (10.11%) compared to other investigated genotypes. Considering the determined weak/medium correlation between body mass and share of breast meat in carcasses (Le Bihan-Duval *et al.*, 1998), the higher share of breast meat of Hubbard chickens is the result of selection-breeding work. Chickens of genotype Farm Q, in spite of significantly low share of breasts (12.58 %) had the share of breast meat (8.09 %) at the level of other investigated slow-growing genotypes (8.60%; 9.07%). In accordance with results of Van Horne *et al.* (2004), shares of thighs with drumsticks, as well as shares of leg meat, showed no statistically significant differences between investigated genotypes. Fanatico *et al*. (2005) reported a higher share of leg meet in slow-growing compared to fast-growing chickens.

CONCLUSION

From the aspect of increase of body mass of chickens, significant effect of genotype can be concluded, whereas relative yields of carcasses were uniform for investigated genotypes, except Farm Q. Share of abdominal fat in chicken carcasses indicates the need for a more balanced diet in extensive rearing system of chickens, as well.

Body composition, i.e. carcass conformation is the result of different directions in selection of slow-growing and fast-growing genotypes for the purpose of their better adjustment to the conditions of extensive or intensive production. Accordingly, significant differences in the share of breast meat between Hubbard Classic and chickens of other genotypes were established.

The established significance of differences between investigated traits within the group of slow-growing genotypes indicates the need for further research of compatibility of certain slow-growing genotype and certain variety of extensive rearing system, for the purpose of maximum expression of the genetic potential.

Indicators of the carcass quality of Hubbard Classic broilers indicate the possibility for their rearing in extensive systems, but further research directed towards meat quality produced in this way is necessary.

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UTICAJ GENOTIPA BROJLERSKIH PILIĆA NA KVALITET TRUPA U EKSTENZIVNOM SISTEMU GAJENJA

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SADRŽAJ

Ovo ispitivanje je obavljeno na pilićima četiri genotipa: dva sporog porasta, Master Gris (MG) i Farm Q (FQ), jednog brzog porasta, Hubbard Classic (HC) i jednog "medium-growing" Red Bro (RB). Pilići su do uzrasta 3 nedelje gajeni po svim tehnološkim normativima intenzivne proizvodnje. Nakon tog perioda, izvršeno je preseljenje pilića i nastavljen je tov u ekstenzivnim uslovima, sa korišćenjem neograničenog ispusta. Utvrđen je signifikantan uticaj genotipa na telesnu masu. Najveću završnu telesnu masu su postigli pilići genotipa Master Gris (1983 g) a najmanju Farm Q (1371 g). Brzo-rastući brojleri genotipa Hubbard Classic su u uzrastu od 84 dana imali telesnu masu u nivou "medium-growing" genotipa Red Bro u uzrastu od 91 dana (1730 g, odnosno 1759 g). U skladu sa utvrđenom telesnom masom, i klanični randmani pilića Farm Q su bili signifikantno najmanji. Takođe, pilići ovog genotipa su imali i značajno ($p<0,05$) manji udeo abdominalne masti u odnosu na ostale genotipove. Pilići genotipa Master Gris i Red Bro su imali značajno veću dužinu piska (22,57 i 21,01 g/mm), dok je kod brzorastućeg genotipa Hubbard Classic utvrđen signifikantno veći grudni ugao (90,15 stepeni). Saglasno tome i udeo grudi (15,90 %), kao i udeo mesa grudi (10,11 %) je bio signifikantno veći u trupu pilića Hubbard Classic.