EFFECT OF GENOTYPE ON PRODUCTIVE QUALITIES OF THE SLOW-GROWING AND FAST GROWING CHICKEN

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ABSTRACT

Five genotypes – four slow and one fast-growing, obtained by the following scheme are object of this study: ♂ M x ♀ Ss, ♂ M x ♀ E, ♂ M x ♀ NG, ♂ M x ♀ F, ♂ M x ♀ L. Chickens were reared under uniform conditions indoor, in groups, on deep permanent wooden shavings litter (indoor – floor system) following the technology used in the selection base of the IA – Stara Zagora. Live weight was measured by individual weighing at 1, 14, 28, 42, 56, 70, and 84 days of age. The hatchability from fertilised eggs was affected by genotype in this study. The highest number of chickens hatched from group II (M x E) – 95.69%, followed by group IV (M x F) – 93.46%, and group V (M x L) – 91.73%. Up to the 56^{th} day of the experiment, group V (M x L) had the best expressed growth capabilities – 1770 g ($p < 0.05$), followed by groups IV (M x F) and II (M x E) with respective weights of 1466.13 g and 1440.31 g. At 70 days of age, group V (M x L) was significantly superior to other groups in males as well as females ($p < 0.05$), reaching, respectively, 3364.62 g and 2537.65 g, followed by groups IV (M x F) and II (M x E) with 2672 g, 2228 g and 2620 g, 2220.75 g. At the end of the experiment, the fast-growing chickens of group V (M x L) reached the highest live weight – 3822.63 g, followed by group IV (M x F) with 3352.57 g and group II (M x E) with 3280.50 g, respectively. There was a significant influence of genotype ($p < 0.001$), sex ($p < 0.001$) and their interaction ($p < 0.05$) with regard to the changes in live weight throughout the period 70 – 84 day. The chickens of group V (M x L) were outlined with the highest index of economic efficiency, 212.67%, followed by groups IV (M x F) and II (M x E) with EPEF values of 184.21% and 175.80%, respectively.

Key words: slower-growing chickens, live weight, productivity, feed consumption, meat quality, growth performance

ВЛИЯНИЕ НА ГЕНОТИПА ВЪРХУ ПРОДУКТИВНИТЕ КАЧЕСТВА НА БАВНОРАСТЯЩИ И БЪРЗОРАСТЯЩИ ПИЛЕТА

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РЕЗЮМЕ

Обект на изследване са получените пет генотипа – четири бавно- и един бързорастящи, получени по следната схема: ♂ M x ♀ Ss, ♂ M x ♀ E, ♂ M x ♀ NG, ♂ M x ♀ F, ♂ M x ♀ L. Пилетата от всички групи бяха отглеждани до 84-я ден при еднакви условия, в затворено помещение, групово, подово, върху дълбока несменяема постеля от дървени стърготини – indoor – floor system, според технологичните изисквания за хранене и гледане, прилагани в селекционната база на ЗИ – Ст. Загора. Живата маса беше контролирана чрез индивидуално претегляне на еднакви интервали. Люпимостта от оплодените яйца е повлияна от генотипа в това проучване. Най-много пилета се люпят от II група (M x E) – 95,69%, следвани от IV група (M x

F) – 93,46%, и V група (M x L) – 91,73%. До 56 ден на опита V група (M x L) има най-добре изразени растежни способности – 1770 g ($p < 0,05$), следвани съответно от IV (M x F) и II (M x E) групи с тегло от 1466,13 g и 1440,31 g. На 70-дневна възраст V група (M x L) превъзхожда достоверно останалите групи както при мъжките, така и при женските птици ($p < 0,05$), достигайки съответно 3364,62 g и 2537,65 g, следвани от IV (M x F) и II (M x E) групи, с 2672 g и 2228 g и 2620 g и 2220,75 g. В края на експеримента бързорастящият тип пилета от V група (M x L) достига най-висока жива маса – 3822,63 g, следвани съответно от IV група (M x F) с 3352,57 g и II група (M x E) 3280,50 g. Налице е високо достоверно влияние на генотипа ($p < 0,001$), пола ($p < 0,001$) и взаимодействието им ($p < 0,05$) по отношение изменението на живата маса в периода 70 – 84 ден. Пилетата от V група (M x L) се отличават с най-висок индекс на икономическа ефективност – 212,67%, следвани съответно от IV (M x F) и II (M x E) групи, с индекси – 184,21% и 175,80%.

Ключови думи: бавнорастящи пилета бройлери, жива маса, разход на фураж, качество на месото, растежни способности

INTRODUCTION

In contemporary intensive broiler production, high mortality is caused by cardio-vascular conditions in birds. In order to reduce economic losses, as well as increase the welfare of the poultry, the breeding of broiler combinations is increasingly being implemented in practice, as they have lower growth rates but good feed conversion. A Dutch study on the future of domestic meat poultry production recommended the choice of a broiler type that would grow more slowly than the current conventional breeds, yet faster than the organic and "Label Rouge" type broilers (Van Harn and Van Middelkoop, 2001). The customer's interest towards this type of "broiler product" is increased because they are eco-friendly, the animals are in good health, and their meat is of better quality and taste (Lewis et al., 1997; Fanatico and Born, 2001; Sauveur, 1997; Sundrum, 2001; Castellini et al., 2002; Gordon and Charls, 2002; Rizzi et al., 2007).

Comparing ISA and Ross kept under extensive systems Farmer et al. (1997) observed a higher mortality rate and poor loco motor activity in the latter. Therefore the choice of a genotype requires a balance between natural production and good conformation, depending on the final purpose of the birds. The parameters describing the productivity of the birds – live weight, growth, feed conversion and conformation depend on important factors such as the bird's genotype and sex (Olawumi and Fagbuaro, 2011; Razuki et al., 2011).

Fast-growing broilers bred under semi-intensive systems give larger yields of white meat and legs than slow-growing ones (Fanatico et al., 2005). There are differences between the two sexes – the males have better developed thighs, while the females have better breast muscles (Takahashi, 2006). Quentin et al. (2003) found out that at the age of one day, the medium-growing broilers M were considerably lighter (34.3 g) than the slow-growing chickens S (40.0 g), while the fast-growing chickens F had a weight of 43.7 g. Towards the end of the study period, at the age of 12 weeks, the S chickens had reached a weight of 2923 g, at 8 weeks of age, the M chickens were at 2619 g, and the F chickens at 6 weeks of age had live weight of 2516 g.

A number of authors have studied the influence of genotype on the growth capacity of slow-growing broilers. Batkowska (2015) differentiation of chicken body weight due to their genotype was observed in all feeding periods of the experiment male chickens obtained by mating Cornish cocks, which are used as male component for commercial broiler chicken production, with Green-legged Partridgenous (GP) or Sussex (Sx) hens (slow growing) were compared with Cobb broilers (fast growing). In week 12, body weight of Sx hybrids constituted 61% of the Cobb's body weight, while that of GP hybrids constituted 39%. Cobb chickens fed extensively were almost 15% heavier than birds of the intensive group. Mikulski et al. (2011) Slower-growing chickens (Hubbard JA957, certified) and fast-growing chickens (Hubbard F15) were fed identical diets until 65 days of age. All chickens were raised for 65 days and had free access to fresh drinking water and were fed ad libitum. The final body weight of SG chickens was approximately 17% lower ($p < 0.01$) than the final body weight of FG chickens, while feed efficiency remained at a comparable level. At the second stage of rearing, mortality rates were threefold lower in SG chickens than in FG birds (1.8% vs. 5.1%).

In their studies, Castellini et al. (2002) tested the productive capabilities and behaviour of chickens belonging to the three productive types – slow-growing Robusta Maculata, medium-growing Kabir, and fast-growing Ross bred at an organic farm, 200 male and female birds from each genotype, over a period of 81 days. The chickens from the first two groups exhibited greater loco motor activity, a positive attitude towards grazing, low mortality rate and slow growth. The Ross chickens exhibited better feed conversion, better growth capacity, but also greater mortality rate and were not well adapted to this type of breeding.

Faria et al. (2010) have conducted an experiment to determine the parameters of the fattening capacity of the two genotypes of birds bred up to the age of 65, 75, 85 and 95 days. One genotype, Paraiso Pedres was distinguished with better growth capabilities compared to the Pescoco Pelado.

On a national scale there are data from the studies of fast-growing broilers per the international standard, specialised in the production of the highest amount of white meat for the shortest amount of time. For the other two types of meat-oriented chickens: a slow-growing „label-type" chicken which takes twice as long as the fast-growing broiler to reach market weight and a hybrid between the two exhibiting an intermediate growth rate no data are available.

In the current study, the goal was to study and compare the production traits and the relation between them and the genotype and sex, of four new combinations of slow-growing and one type of fast-growing broiler chickens derived from crossbreeding of conventional general-purpose hen lines with roosters of the meat-production orientation, kept until the age of 84 days. To accomplish this goal, we set forth the following tasks:

- to determine the hatching qualities of the broiler eggs,
- to determine the influence of the genotype and sex on the growth capabilities of the experimental five genotypes of broiler combinations'
- to determine EPEF on the grounds of registered mortality and feed consumption.

MATERIALS AND METHODS

The experiment was carried out in the breeder farm of the Poultry and Rabbit Selection, Population Genetics, Reproduction and Production Systems Research Department to the Institute of Agriculture – Stara Zagora. Six original lines from the National Gene Pool were used to produce experimental broiler chickens: line Ss, line E, line NG, line F from the all-purpose type were used as maternal forms. The sire line – line M (Cornish) was selected in line with the main purpose: production and investigation of production performance of slow-growing broiler chickens with excellent growth performance, good meat production and quality. It is used for production of conventional broilers together with line L (White Plymouth Rock). Both are from the meat production type.

The five broiler genotypes (4 slow-growing and 1 fast-growing) were obtained using the following breeding schedule:

I. ♂ M x ♀ Ss;
II. ♂ M x ♀ E;
III. ♂ M x ♀ NG;
IV. ♂ M x ♀ F;
V. ♂ M x ♀ L.

Broiler eggs for incubation were produced by breeders at the age of 42 weeks and collected over a week. Fertility rate and hatchability from eggs set and fertile eggs were determined.

For evaluation of genotype on meat traits, five groups with 150 unsexed day-old chickens in each were formed, labelled and vaccinated against Marek's disease and coccidiosis. Chickens were reared under uniform conditions indoor, in groups, on deep permanent wooden shavings litter (indoor – floor system) following the technology used in the selection base of the IA – Stara Zagora. Birds had permanent access to compound feed produced in the fodder plant of the institute, according to birds' age and category. Feeding schedule comprised offering starter (1 – 14 days of age), grower (14 – 28 days of age), finisher (28 – 84 days of age). The composition and nutritional value of compound feeds are listed in Table 1 (AOCA, 1996).

Live weight was measured by individual weighing at 1, 14, 28, 42, 56, 70, and 84 days of age. Feed conversion was evaluated for each genotype and gender for periods between 1 – 14, 14 – 28, 28 – 42, 42 – 56, 56 – 70, 70 – 84 days of age on the basis of feed intake and weight gain. Culled birds were registered on a daily basis. Feed expenditure and livability were determined per 1 kg live weight for each period.

For integral assessment of broiler combinations, the European Poultry efficiency factor (EPEF) was calculated according to the formula:

$$EPEF = \frac{\text{Live body weight (kg) x livability (\%) x 100}}{\text{fattening period (days) x feed intake per 1 kg weight gain.}}$$

Data were statistically analysed to evaluate the effects of genotype and gender using ANOVA/MANOVA and LSD post hoc test (Statistica 8, Stat Soft, 2009).

RESULTS AND DISCUSSION

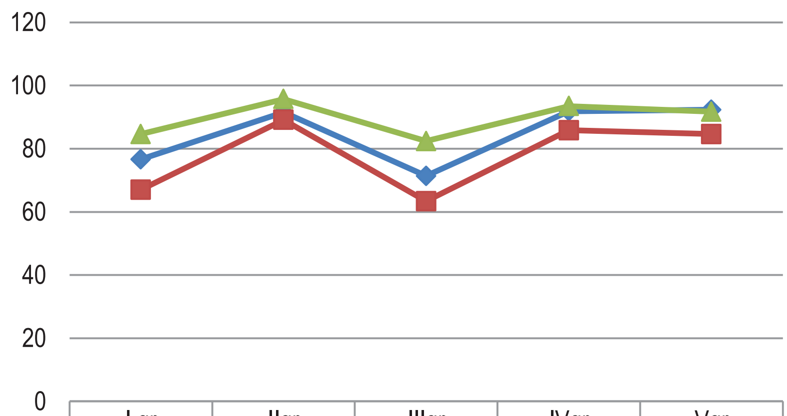
The factors that hatchability depends on are the genetic profile, health status, feeding, flock age, egg weight, season, etc. Also, every strain responded differently to hatchability (Tona et al., 2007). The results from the hatching depend not only on good management, but also on the eggs quality. As a whole, success depends on the percentage of hatched eggs and the number of chickens planned for breeding. It could be said that the profitability of broiler production is directly correlated with the results from the eggs hatchability performance.

(Fig. 1) presents the results from the biological control, more specifically the percentage of fertility, hatchability from set eggs and hatchability from fertilised eggs produced from different genotypes of slow-growing broilers and a conventional fast-growing broiler with Line M as a paternal form. It is notable that three of the studied groups exhibited high rate of egg fertilisation. The highest values in this parameter were exhibited by the eggs from the conventional broiler of V group (M x L) – 92.30%.

The data showed a lack of significant differences regarding the fertility of the set eggs among the studied genotypes of II group (M x E), IV

Table 1. Percentage composition of diets

	Starter 1-14 day	Grower 14-28 day	Finisher 28-84 day
Crude protein, %	21.16	19.37	18.77
Crude fat, %	8.18	5.92	5.90
Metabolic energy, kcal/kg	1927.77	2148.15	2194.26
Crude fiber, %	4.45	4.11	4.12
Ca, %	0.97	0.90	0.78
Digestible phosphorus, %	0.806	0.45	0.69
Methionine, %	0.46	0.44	0.38
Lysine, %	1.19	1.11	0.98



	I gr	IIgr	IIIgr	IVgr	Vgr
fertility %	76,61	91,5	71,38	91,84	92,3
hatchability /set eggs /%	67	89,15	63,38	85,84	84,63
hatchability /fertile eggs /%	84,63	95,69	82,38	93,46	91,73

Figure 1. Fertility and hatchability of slow broiler eggs (%)

group (M x F) and V group (M x L), which was, respectively, 91.5%, 91.84% and 92.30%. The unfertilised eggs from the experimental groups varied between 7.7% and 28.62%. The lower values of 78.61% and 71.38% for the group I combinations (M x Ss) and III group (M x NG) were significant ($p < 0.001$). These results were close to the ones found by Thorne et al. (1991) according to whom unfertilised eggs in the broiler lines varied between 9.8% and 26.8% (16.4% average), while in the egg-oriented lines – between 8% and 27.9 % (11.9% average). According to our data (Oblakova, 2015) the fertility of the conventional line hen eggs participating in the current scheme was high: Line E – 95.68%, Line Ss – 94.89%, Line NG – 94.42%, Line L – 94.73%, Line M – 93.03%, Line F – 84%.

During the eggs incubation, an identical trend was observed for hatchability of set and fertilised eggs with their fertility. The hatchability from fertilised eggs was affected by genotype in this study. The highest number of chickens hatched from group II (M x E) – 95.69%, followed by group IV (M x F) – 93.46%, and group V (M x L) – 91.73%. The differences between group II (M x E) and group IV (M x F) were not relevant. The detected variations on this parameter between groups II and V (M x L); I group; III group (M x NG) had a high degree of significance.

The percentage of hatchability from set eggs was the highest in group II (M x E) – 89.15%, and IV group (M x F) – 85.84%. The variations were only significant with regard to group V – 84.63% ($p < 0.05$) and group I – 67.00% ($p < 0.001$). The lowest hatchability from set eggs was observed in group III (M x NG) – 63.38%. Yassin et al., (2008) also reported a significant difference ($p < 0.001$) in the hatchability of broiler eggs of different genotypes.

Table 2 presents the data on the live weight of the birds up to 56 days of age, depending on the genotype. It is evident that the genotype had a significant effect on the live weight of one-day-old chickens ($p < 0.001$). The chickens from group I (M x Ss) exhibited the lowest values, respectively 35.20 g ($p < 0.05$). In the other groups, this parameter was within the range of 39.20 – 40.63 g, without finding any significant differences. These results could be associated with variations in the mass of the eggs set for hatching. In a study by Hristakieva et al., (2014) the mass of the hatched chickens indicated significant differences between the genotypes ($p < 0.05$).

During the starter period up to 14 days of age, the chickens with the highest growth capability were the ones from group V (M x L) reaching 214.47 g, followed by group IV (M x F) with 172.24 g and group II (M x E) with 152.60 g. The differences between IV group (M x F) and II group (M x E) were proven at $p < 0.05$. The lowest mass at this age was exhibited by the chickens of group III (M x NG) – 114.83 g. The trend persisted throughout the grower period – 28th day, with group V (M x L) reaching 856.60 g were ahead of the other groups in their growth ($p < 0.001$). The differences between the second-ranking in live weight slow-growing broilers of group IV (M x F) with 651.38 g and those of group II (M x E) with 605.19 g were significant as well. The differences between groups V and IV could not be proven.

Genetic potential with regard to live weight within the birds age dynamics had different expression in the examined genotypes. During the first 6 weeks, the chickens from group III (M x NG) exhibited the slowest growth, compared to the other genotypes, and at the age of 42 days gad live weight of 745.45 g ($p < 0.05$). At the same time, the highest values for the chickens from group V (M x L), respectively is 1333.91 g ($p < 0.05$), which had fast growth rates, were measured at this age. The best growth rate among the slow-growing broilers after the conventional ones, were in group IV (M x F) – 1005.91 g. For the indicated period, no significant differences could be found in the live weight of the birds from groups II (M x E) and IV (M x F), which were within the range of 998.45 and 1005.91 g.

Up to the 56th day of the experiment, group V (M x L) had the best-expressed growth capabilities – 1770 g ($p < 0.05$), followed by groups IV (M X F) and II (M x E) with respective weights of 1466.13 g and 1440.31 g. In relative values, the conventional broiler of group V (M x L) reached by 17.19% higher mass than the slow-growing broiler combinations from group IV (M x F). The birds from group IV (M x F) were 1.76% heavier than those of group II. The differences between groups II (M x E) and IV (M x F) were not significant. Such was the trend between groups I (M x Ss) and III (M x NG). In a study by Pauwels et al. (2015), conducted with four broiler hybrids with different growth potentials (Cobb 500, Cobb-Sasso 175, Sasso (XL44 x SA_{51}(A)) and Sussex (Sussex x SA_{51}(A)), it was reported that at the age of 5 weeks the broilers Cobb 500 reached the highest live bodyweight, while Sussex x SA_{51}(A) had the lowest weight. Cobb chickens achieved the highest bodyweight, each week. Sussex chickens always had the lowest bodyweight compared to the breeds with a higher breed-specific growth rate, but there was no significant effect resulting from diet on the bodyweight of Sussex chickens. Longitudinal analysis indicated a significant interaction of the factors breed, diet and time ($p < 0.001$) on the bodyweight.

Table 2. The live weight of the different genotypes different genotypes - g

Genotype	1 day	14 day	28 day	42 day	56 day
I group M x Ss	35.20 ± 0.54b	148.45 ± 2.60c	537.45 ± 12.64d	829.00 ± 16.88c	1226.45 ± 29.47c
II group M x E	40.54 ± 0.30a	152.60 ± 4.10c	605.09 ± 12.93c	998.45 ± 17.51b	1440.31 ± 44.11b
III group M xNG	39.60 ± 0.20a	114.83 ± 3.98d	428.11 ± 17.71be	745.45 ± 27.98	1117.42 ± 46.35c
IV group M x F	39.20 ± 0.76a	172.24 ± 3.10b	651.38 ± 11.70b	1005.91 ± 18.52b	1466.13 ± 43.66b
V group M x L	40.63 ± 0.70a	214.47 ± 5.57a	856.60 ± 19.17a	1333.91 ± 26.82a	1770.65 ± 59.87a
F test	17.74^{***}	75.69^{***}	109.18^{***}	108.52^{***}	30.12^{***}

Different letters within a column indicate statistically significant difference at $^{*}p < 0.05$; $^{***}p < 0.001$

While tracing the results from Table 3 there was an apparent highly significant influence of genotype and sex with regard to the change of live weight with age ($p < 0.001$). The differences per this parameter were preserved while registering the interaction between genotype and sex as well. At 70 days of age, group V (M x L) was significantly superior to other groups in males as well as females ($p < 0.05$), reaching, respectively, 3364.62 g and 2537.65 g, followed by groups IV (M x F) and II (M x E) with 2672 g, 2228 g and 2620 g, 2220.75 g. The differences between the last two groups were not significant. When looking at the effect of sex within the groups, it was determined that male birds had much higher live body weight than the females, revealing the influence of sex on it (Musa et al., 2006). In the conventional broiler of group V (M x L) the males were superior to the females by 24.58%, and in groups IV (M x F) and II (M x E) respectively by 16.62% and 15.24%. The weakest growth qualities were exhibited by the birds from groups I (M x Ss) and III. According to Gordon and Charles, (2002) fast-growing broilers have been selected for rapid growth and reach the market weight at 42 day, middle and slow usually take 62 and 81 days to reach market weight.

The commented trend with regard to live body weight, depending on the genotype and sex, was generally preserved up to the 84th day. It is evident that at the end of the experiment, the fast-growing chicken type (V group M x L) reached the highest live weight, respectively 3822.63 g, while the lowest weight was observed in those of groups I (M x Ss) and III (M x NG) – 2830.32g – 2858.74 g average for both sexes ($p < 0.05$). The slow-growing birds of groups IV (M x F) and II (M x E) reached the live weight preferred by the customers – over 3.200 kg. They had similar values – 3280.50 g – 3352.57 g, and took an average position in our study. In general, it can be noted that when registering the genotype, the differences in live weight between the fast-growing birds of group V (M x L) and the slow-growing birds of groups II (M x E) and IV (M x F) were 12 – 14 %, while for those of groups I (M x Ss) and III (M x NG), they were, respectively, 25 – 26 % ($p < 0.05$).

Comparing the two sexes per a common parameter such as sexual dimorphism is a topic of

Table 3. The live weight of the different genotypes at 70 – 84 day – (g)

Genotype	Sex	70 day	84 day
I group	♂	2203.75 ± 87.16	3113.85 ± 90.05
♂ M x ♀ Ss	♀	1753.33 ± 81.44	2603.64 ± 184.78
	♀+♂	1978.54 ± 73.55c	2858.74 ± 109.11c
II group	♂	2620.00 ± 71.65	3596.00 ± 91.02
♂ M x ♀ E	♀	2220.75 ± 60.37	2965.00 ± 83.01
	♀+♂	2420.00 ± 57.76b	3280.50 ± 80.99b
III group	♂	2100.00 ± 77.36	3011.82 ± 109.34
♂M x ♀НХГ	♀	1955.88 ± 45.11	2648.82 ± 69.94
	♀+♂	2027.94 ± 43.42c	2830.32 ± 68.29c
IV group	♂	2672.00 ± 63.63	3802.50 ± 67.73
♂ M x ♀ F	♀	2228.00 ± 78.82	2902.65 ± 71.24
	♀+♂	2450.00 ± 64.62b	3352.57 ± 93.11b
V group	♂	3364.62 ± 145.76	4249.00 ± 200.75
♂M x ♀ L	♀	2537.65 ± 71.84	3396.25 ± 73.22
	♀+♂	2951.13 ± 105.90a	3822.63 ± 120.18a
F – test			
Genotype (G)		47.72^{***}	28.85^{***}
Sex (S)		80.89^{***}	98.27^{***}
G x S		4.69^{***}	2.46^{*}

Different letters within a column indicate statistically significant difference at * p < 0.05; *** p < 0.001 interest with regard to the equality in terms of live body weight and slaughterhouse processing. Due to the greater differences in live weight between male and female birds, using slow-growing genotypes could affect the equality, with the consequences possibly becoming more significant with age (Fanatico et al., 2005). In the specific case, sexual dimorphism per live weight at the age of 84 days was more strongly expressed in the fast-growing birds of group V (M x L), as well as in the slow-growing birds of group IV (M x F), in which the differences between males and females was 20 – 24% in favour of the former ($p < 0.05$). Tracing this parameter in the rest of the slow-growing genotypes, it was apparent that the difference in live weight between the two sexes was lower, approximately by 12 – 18 %, especially in the birds of group III (M x NG). In contrast with this study's results, Fanatico et al. (2005) found a more apparent sexual dimorphism per live weight in broilers with slow and average growth rate than in those with fast growth rate.

The highest feed consumption during the starter period was exhibited by broiler chickens from the groups with the best growth capacity – in group V (M x L) – 265.10 g and group IV – 215.65 g (Fig. 2). The lowest consumption of 142.79 g was registered in the chickens of group III (M x NG), which also had the lowest live weight at the age of 14. During the growth period (grower) the feed consumption per 1 chicken was the highest in group IV (M x F) – 1017.21 g, reaching 651.38 g weight at the age of 28 days. The slow-growing broilers of group II (M x E) had feed consumption of 957.46 g. The chickens of group V (M x L) reduced consumption during this period, registering 879.60 g of fodder per chicken with a live weight of 856.60 g. Towards the end of the fattening period (finisher) the group with the highest consumption per single chicken was group V (M x L) – 6541.14 g, while the lowest consumption was in group I (M x Ss) – 5921 g. The total feed consumption throughout the entire breeding period for a chicken of group V (M x L) was 7685.84 g, with the individuals of this group having the highest average live weight at the end of the period, followed by group III (M x NG) with feed consumption per chicken for the entire period of 7021.31 g, yet having the lowest live weight. While conducting an 84-day fattening of slow-growing broilers with different genotypes, Takahashi et al. (2006) reported a total feed consumption of 12631g for Ross – 308; 9316 g for Paraíso; 6737 g for Pescoço Pelado; 7359 g for Caipirinha kept in enclosures.

The good result while determining the feed consumption per unit of growth was notable. We believe this was due to the good combination capacity between the used lines, as well as the breeding in indoor areas on deep permanent bedding. According to Wang et al. (2009) the body weigth and weight gain of chickens in the free-range treatment were significantly lower

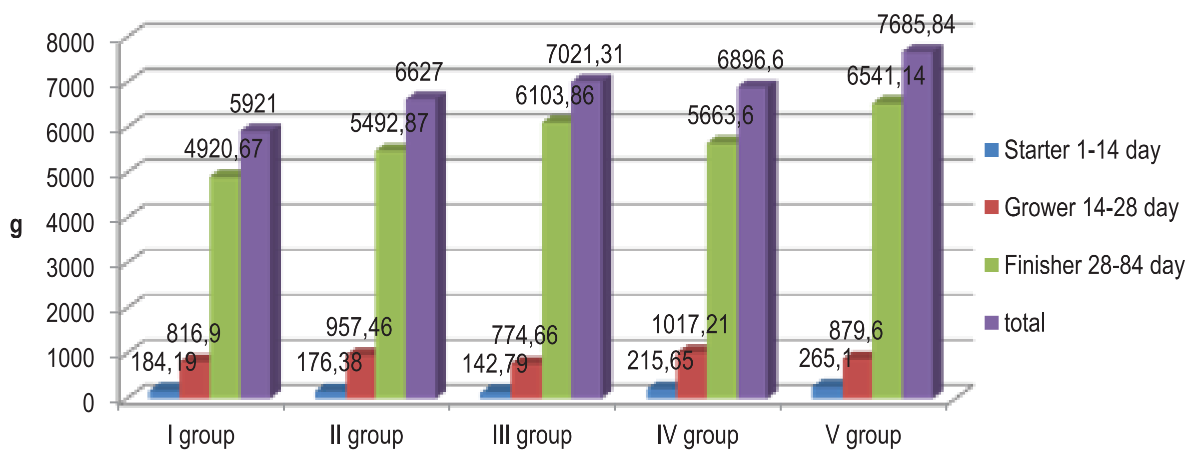


Figure 2. Consumption of feed per 1 chicken (g)

than those of chickens in the indoor treatment ($p < 0.05$). Castellini et al. (2002) also found the same result that growth rates and feed efficiencies with outdoor organic treatments were lower than with conventional treatments. The influence of the paternal form in the crossing of Line M (Cornish) was apparent, through which they came closer to the so-called medium-growing chickens per Quentin et al. (2003), according to whom the feed consumption was 2.4 kg; 2.23 kg, 2.78 kg / 1 kg of growth between the 42 – 56 day for F, M, S-growing broilers.

The fodder conversion during the period from the 1st to 14th day was better in group V (M x L) – 1.525 kg, followed by group II (M x E) with 1.574 kg, IV group (M x F) with 1.621 kg. Relatively, these birds feed consumption for every 1 kg of growth was higher by 3.2% and 6.2%. During the second period – grower (14 – 28 day) the trend persisted the lowest consumption was observed in group V – 1.973 kg, followed by I group (M x Ss), II group (M x E), IV group (M x F) and III group (M x NG). The differences are within the range of 6.6%, 7.2%, 7.6%, up to 20.4%. Feed conversion from the first to the last period was the best in group V (M x L). If reaching 1 kg of growth in this group required 2.01 kg of feed, in groups I (M x Ss) and IV (M x F), II (M x E) and group III (M x NG) it amounted to, respectively, 2.084 kg, 2.10 kg, 2.110 kg and 2.54 kg – Fig. 3.

To make a more objective evaluation of the studied broiler combinations, an index of productivity has been established, an index measuring the extent to which the bred groups fulfil their potential. Analysing the data for this index (Table 4) it is evident that the highest absolute values were found in group V (M x L) – 212.67%; group IV (M x F) – 184.21% and group II (M x E) – 175.80%. The economic efficiency of groups IV (M x F) and II (M x E) compared to group V (M x L) expressed in absolute values was 86.21% and 82.66%. The lowest value of the productivity index was in group III (M x NG) – 127.33%, which was due to the larger feed consumption during the fattening period. In other studies, Mincheva et al. (2015) reviewing the meat productivity of fast-growing broilers of the

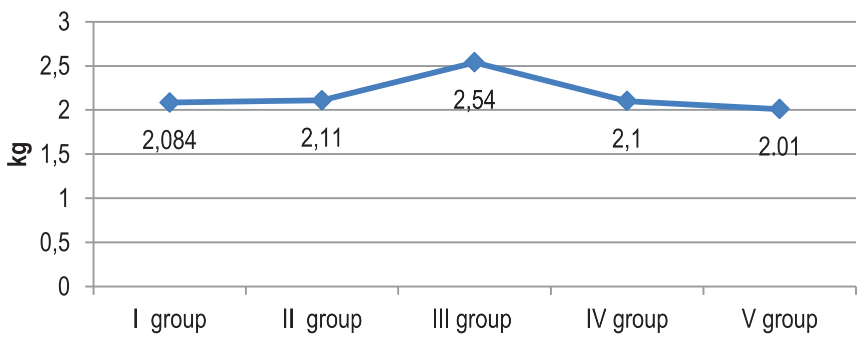


Figure 3. Feed conversion kg/kg

Table 4. European Poultry efficiency factor – Productivity index (PI)

Groups	Live weight at 84 days of age, kg	Livability rate, %	Feed conversion ratio (kg/kg)	EPEF absolute	relative
I ♂M x ♀Ss	2.86	96	2.08	157.14	73.80
II ♂M x ♀E	3.28	95	2.11	175.80	82.66
III ♂M x ♀NG	2.83	96	2.54	127.33	59.87
IV ♂M x ♀F	3.35	97	2.10	184.21	86.21
V ♂M x ♀L	3.82	94	2.01	212.67	100.

combination M x L reported a productivity index – 210.12 in absolute values. By comparison, the conventional Cobb 500 and Ross 308 broilers have registered values of the European Poultry Efficiency Factor absolute – 240.76 and 225.89 (Hristakieva et al., 2014).

CONCLUSIONS

The results of the present study allowed us to make the following conclusions: A significant difference was established in the hatchability of set broiler eggs, group II (M x E) – 89.15% and group IV (M x F) – 85.84% were superior to group V with 84.63% ($p < 0.05$) and group I – 67.00 % ($p < 0.001$). The genotype had a significant effect on the live body weight of one-day-old chickens ($p < 0.001$). Up to 56 days of age there was a significant influence of genotype on the live body weight of broiler combinations. At the end of the experiment, the fast-growing chickens of group V (M x L) reached the highest live weight – 3822.63 g, followed by group IV (M x F) with 3352.57 g and group II (M x E) with 3280.50 g, respectively. There was a significant influence of genotype ($p < 0.001$), sex ($p < 0.001$) and their interaction ($p < 0.05$) with regard to the changes in live weight throughout the period 70 – 84 day. When taking genotype into consideration, the differences in live weight between the fast-growing birds of group V (M x L) and the slow-growing ones of groups II and IV were 12 – 14%, and with those of groups I and III, respectively 25 – 26% ($p < 0.05$). The feed consumption per kg of growth was the lowest in group V, groups II and IV. The chickens of group V (M x L) were outlined with the highest index of economic efficiency – 212.67%, followed by groups IV (M x F) and II (M x E) with EPEF values of 184.21% and 175.80%, respectively, representing 86.21% and 82.66% of EPEF of group V.

On the grounds of the conclusions, the following practical recommendations can be made:

Chickens from group IV (M x F), group II (M x E), as well as group V (M x L) can be offered for the production of slow-growing, raised up to the 84^{th} day under the indoor– floor system.

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