NATIONAL AGRICULTURAL AND FOOD CENTRE
RESEARCH INSTITUTE FOR ANIMAL PRODUCTION NITRA

Slovak J. Anim. Sci., 47, 2014 (1): 19-24

ISSN 1337-9984

EFFECT OF GENOTYPE ON PRODUCTION TRAITS IN BROILER CHICKENS

P. HRISTAKIEVA*, N. MINCHEVA, M. OBLAKOVA, M. LALEV, I. IVANOVA

Agricultural Institute - Stara Zagora, Bulgaria

ABSTRACT

The study was carried out on two broiler chicken genotypes Ross 308 and Cobb 500 in the nucleus poultry farm of the Institute of Agriculture – Stara Zagora between April and June 2012. For this purpose, 300 eggs of each genotype were set for incubation to compare the meat traits of two of the most popular broiler chicken hybrids: Cobb 500 and Ross 308 reared at the nucleus poultry farm of the Institute of Agriculture – Stara Zagora. The fertility rate, embryonic death rate, weight loss between incubation days 0 and 18, and the hatchability of set and fertilized eggs were determined. The number of chickens included in the study was 100 from each genotype (50 male and 50 female). Experimental birds were reared on wooden shavings bedded floor, with constant access to compound feed according to the age until 49 days of age. The live body weight was determined individually by weighing birds at 1, 14, 28, 42 and 49 days of age. By the end of the experiment, a slaughter analysis of three female and three male broilers with a live weight close to the group average was performed. For integral assessment of broiler combinations, the European Poultry efficiency factor (EPEF) was calculated. The results of the present experiments showed a number of differences in meat and slaughter traits between studied broiler chicken hybrids. The weight of hatchlings differed significantly according to the genotype ($p<0.05$). One-day-old Cobb 500 broilers were heavier than Ross 308 broilers. At the end of the experiment, Cobb 500 broilers attained a higher live weight, and were heavier than Ross 308 birds by 6.29 %. The feed intake per kg weight gain over the entire experimental period was 2.178 kg and 2.181 kg for Ross 308 and Cobb 500, respectively. Higher values of the European Poultry Efficiency Factor (EPEF) were established in Cobb 500 broilers, which were more economically efficient than Ross 308 by 14.87 points (6.18 %). The performed slaughter analysis showed higher values of slaughter traits in Cobb 500, which had higher growth potential: roasting weight 1810.67 g and grilling weight 1710.50 g; whereas the respective values in Ross 308 chickens were 1547.67 g for grilling and 1645 g for roasting. In male Cobb 500 broiler chickens, the roasting percentage was 74.02 %, which was 1.41 % more than that of Ross 308 males. The same trend was observed in female birds as well, i.e.

Key words: broiler; European Poultry Efficiency Factor (EPEF); body weight; Cobb 500; Ross 308; slaughter analysis

INTRODUCTION

The modern broiler chicken production is an extensive and rapidly developing sector, supplying the market with relatively cheap and high-quality dietetic food. Due to contemporary selection programmes, a considerable improvement of weight gain, feed conversion, slaughter yield and breast meat yields were achieved during the past decades (Chambers *et al*., 1981, Havenstein *et al*., 1994a, 1994b). The progress in the selection of meat type chickens resulted in significantly shorter fattening period up to 42 days of age at slaughter weight of 2 kg (Havenstein *et al*., 2003).

Regardless of genetic improvements performed by breeders, broiler hybrids still differ with regard to their efficiency due to the specific selection practices (Emmerson, 1997). Hence the evaluation of promising crosses selected for high live weight, high weight gain, feed conversion, carcass traits and adaptation potential would highly contribute to the high efficiency of broiler chicken produce.

The aforementioned traits depend on numerous

***Correspondence:** E-mail: poly_31@abv.bg
Pavlina Hristakieva, Agricultural Institute - Stara Zagora, 6000 Bulgaria

Received: April 24, 2013
Accepted:Janury 9, 2014

factors, including the genotype and the gender. Many researchers have reported a substantial effect of the genotype on live weight (Ojedapo *et al*., 2008; Razuki *et al*., 2011), feed conversion, carcass composition (Havenstein *et al*., 2003; Santos *et al*., 2004; Marcato *et al*., 2006; Nikolova and Pavlovski, 2009), carcass weight (Rondelli *et al*., 2003), and abdominal fat (Barbato, 1992; Fontana *et al*., 1993).

A number of experiments have showed that the live body weight was also influenced by the gender (Sheuerman *et al.*, 2003; Musa *et al*., 2006), feed intake and utilization (Smith *et al*., 1998), abdominal fat content and the carcass composition. In a study of slaughter traits of five different turkey genotypes, Hristakieva *et al*. (2005) established a higher percentage of the grill from the live weight in females compared to male broilers. A number of studies demonstrated that female broilers have higher breast proportions, while in males the proportion of thighs was higher (Young *et al.*, 2001; Nikolova and Pavlovski, 2009; Abdullah *et al.*, 2010). In addition, Mendes *et al.* (2004) established lower abdominal fat percentage in males than in females.

The purpose of the present experiment was to compare the meat traits of two of the most popular broiler chicken hybrids Cobb 500 and Ross 308.

MATERIAL AND METHODS

The experiment was carried out in the nucleus poultry farm of the Institute of Agriculture - Stara Zagora between April and June 2012. Two broiler chicken genotypes were studied: Ross 308 and Cobb 500. For this purpose, 300 eggs of each genotype were set for incubation. The fertility rate, embryonic death rate, weight loss between incubation days 0 and 18, and the hatchability of set and fertilized eggs were determined. The number of chickens included in the study was 100 from each genotype (50 male and 50 female). The sexing was done at one day age. Experimental birds were reared on wooden shavings bedded floor, with constant access to compound feed according to the age until 49 days of age.

The live body weight was determined individually by weighing birds at 1, 14, 28, 42 and 49 days of age. Feed conversion was calculated for each genotype and for the periods between 1-14, 14-28, 28-42 and 43-49 days of age on the basis of feed intake and weight gain.

By the end of the experiment, a slaughter analysis of three female and three male broilers with a live weight close to the group average was performed. After a 12-hour fasting the live body weight as well as the weight after grilling, weight of different carcass parts (breast, thighs, wings), weight of edible offal (heart, liver, gizzard) and weight of abdominal fats were determined. The slaughter yield and carcass ratios were calculated.

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

$$\text{EPEF} = \frac{\text{live body weight (kg) x livability (\%) x 100}}{\text{fattening period (days) x feed efficiency}}$$

Data were statistically processed according to the gender and genotype by ANOVA/MANOVA and LSD post hoc test using Statistica 8 software (StatSoft, 2009). Results were considered significant when $P<0.05$. The percentages were arc sine transformed prior to the analysis.

RESULTS AND DISCUSSION

Table 1 presents the weight of incubated eggs, the loss in their weight for the first 18 days of incubation and the outcome of incubation. The weight of Cobb 500 incubation eggs was significantly higher than the average weight of Ross 308 eggs by 2.12 g.

Table 1: Incubation traits of eggs from Ross 308 and Cobb 500 genotypes

Genotype	Weight of incubation eggs (g)	Weight loss of incubation eggs % (days 0-18)	Fertility rate %	Embryonic death rate %	Hatchability %	
					from eggs set	from fertilized eggs
Ross 308	66.54 ± 0.34[b]	15.91 ± 0.15[a]	84.17 ± 0.84[a]	8.42 ± 0.58[a]	77.08 ± 1.25[a]	91.58 ± 0.58[a]
Cobb 500	68.66 ± 0.46[a]	14.74 ± 0.36[b]	86.36 ± 3.76[a]	9.34 ± 1.91[a]	78.18 ± 2.32[a]	90.66 ± 1.91[a]

[a – b] – different letters within a column indicate statistically significant differences at $P<0.05$

Table 2: Live body weight of broilers (g) depending on the genotype and the gender at different ages

Factors	Age, days				
	1 day	14 days	28 days	42 days	49 days
Genotype					
Ross 308	42.86 ± 0.39[b]	381.66 ± 3.83[a]	1115.95 ± 11.49[a]	2019.60 ± 19.67[b]	2435.29 ± 19.50[b]
Cobb 500	44.96 ± 0.38[a]	334.52 ± 3.89[b]	1069.29 ± 9.42[b]	2188.54 ± 24.63[a]	2598.91 ± 24.76[a]
Gender			Male		
Ross 308	43.04 ± 0.48[b]	384.21 ± 5.15[a]	1119.96 ± 16.53[a]	2052.89 ± 30.69[b]	2462.31 ± 31.58[b]
Cobb 500	45.87 ± 0.46[a]	330.98 ± 4.93[b]	1075.74 ± 13.25[b]	2257.93 ± 33.78[a]	2672.14 ± 34.43[a]
			Female		
Ross 308	42.68 ± 0.61[ab]	379.10 ± 5.69[a]	1111.94 ± 16.10[a]	1986.30 ± 24.12[b]	2412.39 ± 23.90[a]
Cobb 500	44.03 ± 0.62[a]	338.05 ± 6.36[b]	1062.84 ± 12.68[b]	2119.14 ± 28.95[a]	2485.00 ± 23.70[a]

[a – b] – different letters within a column indicate statistically significant differences at $P < 0.05$

The relative loss of egg weight until the 18[th] incubation day was lower in Cobb 500 (14.74 %) than in Ross 308 (15.91 %). These data confirmed the earlier results of Tona *et al.* (2010) that the weight loss of Ross eggs was higher than that of Cobb eggs. The results did not demonstrate any statistically significant differences with regard to embryonic death rate, fertility and hatchability of set and fertilized eggs between studied genotypes.

Table 2 presents the data about live body weight of chickens at different ages depending on the genotype and the gender. The weight of hatchlings differed significantly between genotypes. Higher values were obtained for Cobb 500 broilers (44.96 g) than for Ross 308 (42.86 g). These differences could be associated at the highest extent to differences in the weight of incubation eggs (Table 1).

Comparison of genotypes showed that Ross 308 hybrids were superior to Cobb 500 at the beginning of the fattening period despite the lower live weight at hatching of both genders which was preserved until the 28[th] day of age. Therefore, their weight gain rate until that age was more rapid. By the end of the experiment, Cobb 500 broilers attained higher average live weight, which was 6.29 % more than that of Ross 308.

This trend was also valid for male Cobb 500 broilers when the combined effects of genotype and gender were accounted for. Cobb 500 males were by 7.85 % heavier than Ross 308 males, whereas the differences between Cobb and Ross female broilers were

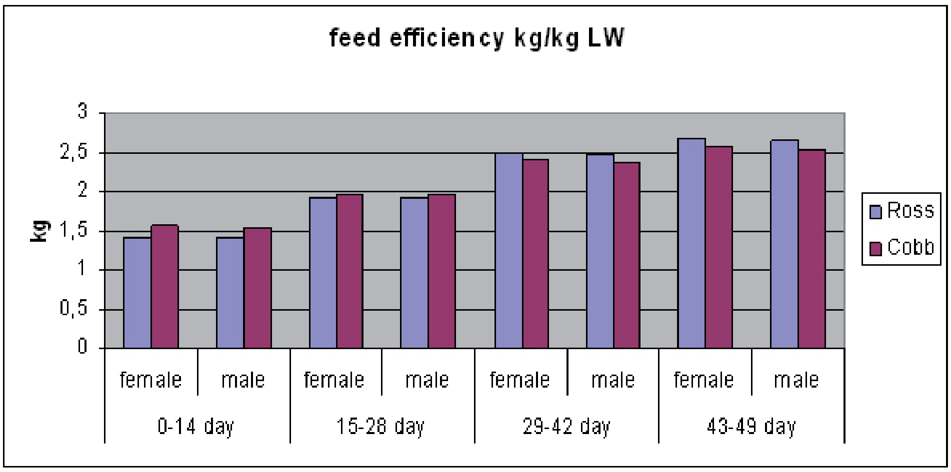

Fig. 1: Feed efficiency

statistically insignificant.

The dynamics in live body weight depending on the gender showed substantial differences between male and female broilers by the 42nd day of age by 6.15 % for Cobb 500 at 49 days of age. The differences between male and female Ross 308 broilers were 3.2 % at 42 days of age and even lower (2.02 %) by the end of the experiment.

Feed conversion between 1 and 14 days of age was more efficient (9-19 % higher) in male and female Ross 308 broilers than Cobb 500, whereas during the second period the values were comparable and the difference was very small (2 %) (Fig. 1).

Within the period from the 29th to the 42nd day of age, there were no differences in feed conversion between genders. Ross 308 chickens exhibited a slightly lower feed conversion compared to Cobb 500. This trend was also present between the 43rd and the 49th day of age. Over the entire experimental period, the feed intake for 1 kg weight gain for Ross 308 and Cobb 500 birds was 2.178 kg and 2.181 kg, respectively.

For better evaluation of studied broiler combinations the European Poultry Efficiency Factor was calculated, which indicates the level of genetic potential utilization of a hybrid. The EPEF data (Table 3) demonstrated that Cobb 500 birds had higher values. i.e. a higher economic efficiency than Ross 308 by 14.87 points (6.18 %).

Table 3: European Poultry Efficiency Factor

Genotype	Body weight at 49 days of age, kg	Livability, %	Feed conversion (kg/kg)	EPEF	
				Absolute	Relative
Ross 308	2.435	99	2.178	225.89	93.82
Cobb 500	2.599	99	2.181	240.76	100

Table 4 presents the slaughter analysis results depending on the genotype and the gender. The differences in pre-slaughter weight reflected upon roasting and grilling weights. The slaughter analysis showed higher values of these traits in both genders of Cobb 500 broilers that are outlined with a higher growth potential (1810.67 g for roasting and 1710.50 g for grilling weight) in comparison to Ross 308 broiler chickens (1645 g for roasting and 1547.67 g for grilling weight).

In the present experiment, the difference between pre-slaughter live weight of male and female birds did not entail statistically significantly changes in either grilling or roasting weights. Evidently, the body weight increase was due to body parts that do not participate in slaughter yield formation. A similar opinion was reported by Abdullah *et al*. (2010). In general, female broilers had higher breast weight and breast proportion from the grill than males, while the males had higher absolute and relative thigh weight. Our data were in agreement with those reported by Mendes *et al.* (2004), Santos *et al.* (2004) and Abdullah *et al*. (2010).

The comparison of breast and thigh weight with regard to the genotype once again showed the superiority of Cobb 500, which exhibited higher breast weight by 81 g and higher thigh weight by 25.33 g than Ross 308 broilers. The wings' weight was higher in Cobb 500 (188.33 g) than in Ross 308 (178.33 g).

Table 5 presents relative proportions of studied carcass traits. Roasting and grilling, presented as percentage of the live weight, attained statistically higher values in Cobb 500 broilers both with regard to the genotype and the gender. The roasting of male Cobb 500 was 1.41 % higher than that of male Ross 308. Similar trends were seen in female Cobb 500 which was superior to female Ross 308. The differences with regard to other traits between both genders of Cobb 500 and Ross 308 were insignificant. In general, female broilers had higher grilling percentage from the live, higher breast and weight and percentage weight, but lower thigh weight and percentage than males. Our results support those of Mendes *et al*. (2004), Santos *et al*. (2004), Hristakieva *et al.* (2005) and Abdullah *et al*. (2010).

CONCLUSION

The results of present experiment showed a number of differences in meat and slaughter traits between studied broiler chicken hybrids. Coob 500 broilers had higher productive performance compared Ross 308 under the same growing conditions.

The weight of hatchlings differed significantly according to the genotype. One-day-old Cobb 500

Table 4: Slaughter traits of broiler chickens depending on the genotype and the gender

Factors	Live weight, g	Roasting, g	Grilling, g	Breast, g	Thighs, g	Wings, g
Genotype						
Ross 308	2241.67 ± 20.72[b]	1645.00 ± 16.45[b]	1547.67 ± 17.73[b]	406.67 ± 14.69[b]	527.67 ± 12.46[b]	178.33 ± 3.22[ab]
Cobb 500	2411.67 ± 29.71[a]	1810.67 ± 23.41[a]	1710.50 ± 24.21[a]	487.67 ± 23.45[a]	553.00 ± 20.95[a]	188.33 ± 4.38[a]
Gender			Male			
Ross 308	2276.67 ± 29.63[b]	1654.00 ± 29.46[b]	1556.00 ± 31.56[b]	396.33 ± 23.05[ab]	546.33 ± 20.54[ab]	183.67 ± 1.76[ab]
Cobb 500	2456.67 ± 42.56[a]	1819.67 ± 47.81[a]	1716.00 ± 52.14[a]	438.67 ± 8.21[a]	586.67 ± 32.19[a]	192.33 ± 3.18[a]
			Female			
Ross 308	2206.67 ± 6.67[abc]	1636.00 ± 20.11[b]	1539.33 ± 22.48[b]	417.00 ± 21.00[bc]	509.00 ± 2.52[a]	173.00 ± 4.51[a]
Cobb 500	2366.67 ± 24.04[a]	1801.67 ± 19.34[a]	1705.00 ± 13.43[a]	536.67 ± 16.76[a]	519.33 ± 4.98[a]	184.33 ± 8.35[a]

[a – b – c] – different letters within a column indicate statistically significant differences at $P < 0.05$

broilers were heavier than Ross 308 broilers. At the end of the experiment, Cobb 500 broilers attained a higher live weight, and were heavier than Ross 308 birds by 6.29 %. The feed intake per kg weight gain over the entire experimental period was 2.178 kg and 2.181 kg for Ross 308 and Cobb 500, respectively. Higher values of the European Poultry Efficiency Factor were established in Cobb 500 broilers, which were more economically efficient than Ross 308 by 14.87 points (6.18 %). The performed slaughter analysis showed higher values of slaughter traits in Cobb 500, which had higher growth potential (roasting weight 1810.67 g and grilling weight 1710.50 g in Cobb 500 while 1645 g for roasting and 1547.67 g for grilling in Ross 308 broilers, respectively). In male Cobb 500 broiler chickens, the roasting percentage was 74.02 %, which was 1.41 % higher than that of Ross 308 males. The same trend were observed in female birds as well, i.e. superiority of Cobb 500 over Ross 308.

Table 5: Slaughter yield and slaughter traits (%)

Factors	Roasting, % of live weight	Grilling, % of live weight	Breast, % of grill	Thighs, % of grill	Wings, % of grill
Genotype					
Ross 308	73.39[b]	69.04[a]	26.27[b]	34.09[b]	11.40[a]
Cobb 500	75.10[a]	70.94[b]	28.53[a]	32.31[a]	11.02[a]
			Male		
Ross 308	72.66[a]	68.33[a]	25.47[a]	35.11[a]	11.81[a]
Cobb 500	74.05[b]	69.83[b]	25.58[a]	34.15[a]	11.23[a]
			Female		
Ross 308	74.14[a]	69.75[a]	27.07[b]	33.08[b]	10.98[a]
Cobb 500	76.14[a]	72.06[a]	31.48[a]	30.46[a]	10.81[a]

[a – b] – different letters within a column indicate statistically significant differences at $P < 0.05$

REFERENCES

ABDULLAH, Y. A. – AL-BEITAWI, A. N – RJOUP, M. S. – QUDSIEH, I. R. – ISHMAIS, A. A. 2010. Growth performance, carcass and meat quality characteristics of different commercial crosses of broiler strains of chicken. *The Journal of Poultry Science*, vol. 47 (1), 2010, p. 13-21.

BARBATO, G. F. 1992. Genetic architecture of carcass composition in chickens. *Poultry Science*, vol. 71 (5), 1992, p. 789-798.

CHAMBERS, J. R. – GAVORA, J. S. – FORTIN, A. 1981. Genetic changes in meat-type chickens in the last twenty years. *Canadian Journal of Animal Science*, vol. 61 (3), 1981, p. 555-563.

EMMERSON, D. A. 1997. Commercial approaches to genetic selection for growth and feed conversion in domestic poultry. *Poultry Science*, vol. 76 (8), 1997, p. 1121-1125.

FONTANA, E. A. – WEAVER, W. D. Jr. – DENBOW, D. M. – WATKINS, B. A. 1993. Early feed restriction of broilers: Efects on abdominal fat pad, liver, and gizzard weights, fat deposition and carcass composition. *Poultry Science*, vol. 72 (2), 1993, p. 243-250.

HAVENSTEIN, G. B. – FERKET, P. R. – SCHEIDELER, S. E. – LARSON, B. T. 1994a. Growth, livability, and feed conversion of 1957 vs 1991 broilers when fed “Typical” 1957 and 1991 broiler diets. *Poultry Science*, vol. 73 (12), 1994, p. 1785-1794.

HAVENSTEIN, G. B. – FERKET, P. R. – SCHEIDELER, S. E. – RIVES, D. V. 1994b. Carcass composition and yield of 1991 vs 1957 broilers when fed “Typical” 1957 and 1991 broiler diets. *Poultry Science*, vol. 73 (12), 1994, p. 1795-1804.

HAVENSTEIN, G. B. – FERKET, P. R. – QURESHI, M. A. 2003. Carcass composition and yield of 1957 versus 2001 broilers fed representative 1957 and 2001 broiler diets. *Poultry Science*, vol. 82 (10), 2003, p. 1509-1518.

HRISTAKIEVA, P. – OBLAKOVA, M. – LALEV, M. 2005. A study on the productivity in turkey-broilers I. Slaughter analysis and assessment of meat quality in turkey-broilers at age of 16-weeks. *Int. Sci. Conf. of Union of Bulgarian Scientists in Stara Zagora*, 1-2 June 2005, III, p. 68-77.

MARKATO, S. M. – SAKOMURA, N. K. – KAWAUCHI, I. M. – BARBOSAN, A. A. – FREITAS, E. C. 2006. Growth of body parts of two broiler chicken strain. *XII European Poultry Conference*, 10-14 September 2006, Verona, Italy. Abstr., M7, 270.

MENDES, A. A. – MOREUIRA, J. – OLIVEIRA, E. G. 2004. Effect of dietary energy on performance, carcass yield and abdominal fat of broiler chickens. *Revista Brasileira de Zootecnia*, 33 (6), 2004, p. 2300-2307.

MUSA, H. H. – CHEN, G. H. – CHENG, J. H. – LI, B. C. – MEKKI, D. M. 2006. Study on carcass characteristics of chicken breeds raised under the intensive condition. *International Journal of Poultry Science*, vol. 5 (6), 2006, p. 530-533.

NIKOLOVA, N. – PAVLOVSKI, Z. 2009. Major carcass parts of broiler chicken from different genotype, sex, age and nutrition system. *Biotechnology in Animal Husbandry*, vol. 25 (5-6), 2009, p. 1045-1054.

OJEDAPO, L. O. – AKINOKUN, O. – ADEDEJI, T. A. – OLAYENI, T. B. – AMEEN, S. A. – AMAO, S. R. 2008. Effect of strain and sex on carcass characteristics of three commercial broilers reared in deep litter system in derived savanna area of Nigeria. *World Journal of Agricultural Science*, vol. 4 (4), 2008, p. 487-491.

RAZUKI, W. M. – MUKHLIS, S. A. – JASMIN, F. H. – HAMAD, R. F. 2011. Productive performance of four commercial broiler genotypes reared under high ambient temperatures. *International Journal of Poultry Science*, vol. 10 (2), 2011, p. 87-92.

RONDELLI, S. – MARTINEZ, O. – GARCIA, P. T. 2003. Sex effect on productive parameters, carcass and body fat composition of two commercial broilers lines. *Revista Brasileira de Ciência Avícola*, 5 (3), 2003, p. 169-173.

SANTOS, A. L. – SAKOMURA, E. R. – FREITAS, E. R. – BARBOSA, N. A. A. - MENDONCA, M. O. – CARRILHO, E. N. V. M. 2004. Carcass yield and meat quality of three strains of broiler chicken. *Proc. of XXII World Poultry Congress*, WPSA Turkish Branch, 8-13 Jun 2004, Istanbul, Turkey.

SCHEUERMANN, G. N. – BILILI, S. F. – HESS, J. B. – MULVANEY, D. R. 2003. Breast muscle development in commercial broiler chickens. *Poultry Science*, vol. 82 (10), 2003, p. 1648-1658.

SMITH, E. R. – PESTI, G. M. – BALKALLI, R. I. – WARE, G. O. – MENTEN, J. F. 1998. Further studies on the influence of genotype and dietary protein on the performance of broilers. *Poultry Science*, vol. 77 (11), 1998, p. 1678-1687.

TONA, K. – ONAGBESAN, O. M. – KAMERS, B. – EVERAERT, N. – BRUGGEMAN, V. – DECYPERE, E. 2010. Comparison of Cobb and Ross strains in embryo physiology and chick juvenile growth. *Poultry Science*, vol. 89 (8), 2010, p. 1677-1683.

YOUNG, L. L. – NORTHCUTT, J. K. – BUHR, R. J. – LYON, C. E. – WARE, G. O. 2001. Effect of age, sex, and duration of postmortem aging on percentage yield of parts from broiler chicken carcasses. *Poultry Science*, vol. 80 (3), 2001, p. 376-379.