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Full Length Research Paper

Carcass characteristics of two strains of native broilers (White Naked Neck and Black Svrljig) fattened under a semi-intensive system

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This study involves the analysis of two breeds [Naked Neck (NN) and Svrljig chickens (Sv)], that is, strains [White Naked Neck (WNN) and Black Svrljig strain (BSv)] of chickens (birds) of both sexes reared under a semi-intensive system until day 84 of age. At 28 days of age, the test birds were kept in a litter housing system (about 8 birds/m^2), following which they were provided a free-range paddock at 4 m^2/bird. The following parameters were evaluated in the two strains and sexes of broilers (totalling 56 chickens) aged 84 days: body weight at slaughter, carcass weight, yields of breasts, thighs, drumsticks, wings, pelvis, back, head, neck, feet, abdominal fat and giblets. At the end of the fattening period, the test broilers of both sexes of the WNN strain had higher values (P<0.05) for yield of drumsticks and thighs (34.20 to 33.93%), a statistically lower yield (P<0.01) of the back and pelvis (26.34 to 26.97%), and a somewhat higher live body weight (1587.07 to 1562.28 g). The difference was not statistically significant (P>0.05); however, a similar yield was obtained for ready to grill carcass (61.73 to 61.99%) when compared with the black Svrljig strain. The differences obtained were not statistically significant (P>0.05). In addition to the genotype (breed, strain), broiler sex had a statistically significant effect (P<0.001*;* P<0.01*;* P<0.05) on body weight, carcass yield, yields of drumsticks and thighs, wings, head, feet, giblets and abdominal fat. Specifically, male broilers were found to have higher live body weight (1669.29 to 1480.07 g), carcass weight (1342.86 to 1198.28 g), yields of head (5.13 to 4.39%), drumsticks and thighs (34.26 to 33.96%), feet (5.39 to 5.06%) and giblets (6.46 to 6.31%), whereas the relative yields of carcass (conventional processing (CP): 80.96 to 80.44%; ready to roast (RR): 73.02 to 72.19%; ready to grill (RG): 62.30 to 61.45%), wings (14.06 to 13.76%) and abdominal fat (1.13 to 1.07%) were higher in female broilers.

Key words: Semi-intensive system, carcass quality, sex, white naked neck strain, black Svrljig strain, organic production.

INTRODUCTION

The regulation on organic livestock production methods adopted by the Republic of Serbia in 2002 stipulates, inter alia methods of organic poultry production required to define choice, type and breed of poultry, rearing system, nutrition, disease prevention and health protection of poultry. In recent years, it returned to natural that open farming or organic livestock production has attracted increasing attention aimed at improving rearing conditions, enhancing poultry meat and egg quality, advancing the development of organic animal-derived food production, reducing production costs and protecting the environment. The free range production of chicken meat is regulated by the European Union (EU Directive EWG

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1538/91); although, organic livestock farming was defined by basic guidelines (European economic community (EEC) - the regulation on organic agriculture /EEC/ No. 1804/1999). EU regulations (recommendations, directives and decisions) on chicken meat production are generally focused on changing rearing conditions (conventional-commercial-intensive) towards the modification and elimination of cramped and overcrowded conditions, and making use of a new approach for certain zootechnical and veterinary practices. Due to these regulations, a considerable number of studies have been dedicated to identifying broiler breeds, strains or hybrids most suitable for organic (ecological) production of poultry (broiler) meat under specific rearing systems (semi-intensive, semi-extensive and extensive systems), thereby providing adequate nutrition and optimal length for the fattening period. Van Marle-Köster and Webb (2000) assessed the carcass traits of six native lines (one of which is the Naked-Neck breed) and one commercial hybrid (Cobb) fattened until day 77 of age. Sabbioni et al. (2006) evaluated the life weight, yield of carcass, breast, drumsticks and thighs in male broilers of two Italian autochthonous breeds (Modenese and Romagnolo) and one commercial hybrid (Hy-Line W 36) reared outdoor (about 4 m^2/bird) until about 210 days of age.

Considerably, lower weight in the Italian breed Robusta Maculata (1670 g) was reported by Castellini et al. (2002a) at 81 days of age. Grashorn (2006) studied two slow-growing strains (Isa S 457 - Brown Feathered and Isa J 957 - White) and two fast-growing strains (Hubbard JV - white and Ross 308 - white) fattened until 84 days of age. Faria et al. (2010) examined the carcass traits of two strains of male and female broilers (P. Pedres and P. Pelado) reared under a semi-extensive system and slaughtered at 65, 75, 85 and 95 days of age. Castellini et al. (2002b) evaluated the effect of two rearing systems (conventional and organic rearing) on carcass yield and meat quality of male Ross broilers fattened until days 56 and 81 of age. Another interesting research was conducted by Lichovníková et al. (2009) who provided a parallel analysis of fattening and slaughter results in two male broiler genotypes, including Isabrown [a slow-growing genotype, (IB)] and Ross 308 [a fast-growing genotype, (RS)], fattened until 90 days of age. Similar studies were undertaken by Hardy and Denman. (1975), Gerken et al. (2003), Damme and Ristic (2003), Lonergan et al. (2003), Souza (2004), Takahashi et al. (2006), Coelho et al. (2007), and Grashorn and Clostermann (2002) in different genotypes, that is, in broilers of different slaughter ages. However, only a limited literature on this matter has been published in the Republic of Serbia regardless of the increasing attention being given in the last few decades to the preservation of autochthonous breeds and strains of poultry to be actively used in organic broiler meat pro-duction under semi-intensive, semi-extensive and extensive rearing systems.

To this end, a number of studies were conducted, including those o f Mašić et al. (1996, 1997), Supić et al. (1997), Mitrović et al. (2005), Milošević et al. (2005), Blagojević et al. (2009), Pavlovski et al. (2009) and Bogosavljević-Bošković et al. (2006a, 2006b, 2010). Pavlovski et al. (2009) studied the body weight gains and slaughter traits in different strains of Naked Neck broilers (white, black and grey strains), reared in Serbia and the French hybrid Naked Neck Farm Q, fattened until 91 and 98 days of age, respectively, under an extensive system. Bogosavljević-Bošković et al. (2010) determined the slaughter traits and chemical composition of broiler meat in fast-growing Hybro G fattened until 56 days of age under extensive indoor and free range rearing systems. In overall terms, most authors suggest that genotype, sex, length of fattening period and rearing system have a significant effect on fattening and slaughter traits (including growth, feed consumption, body weight, carcass yield, yields of breast, drumsticks, thighs, abdominal fat and giblets), and on production of quality organic meat. Moreover, pure breeds or strains of broilers have recently gained increasing importance in many countries worldwide in the production of organic (ecological) poultry meat under semi-intensive, semi-extensive and extensive rearing systems. Similar to the objectives of the afore-mentioned authors, the main objective of this study was to compare and analyse the slaughter traits found in two native strains (the White Naked Neck and the Black Svrljig) of broilers reared under a semi-intensive system until 84 days of age.

MATERIALS AND METHODS

The most popular autochthonous broiler breed in Serbia is the Svrljig breed, especially the black strain, most widely reared in rural areas, that is, rural households (Mitrović, 1996). The Svrljig breed was developed in the Svrljig region in the mid-20th century by crossing the then native hen breed with a different number of breeds, mostly the Australorp and the Langshan, which were imported into Serbia (Mašić et al., 1996, 1997; Supić et al., 1977; Mitrović et al., 2005, 2011). The naked neck is widespread in almost all regions of the world; however, due to its distinctive appearance and origin, it is also called the Transylvanian naked neck, the Turken or the Kaalnek in South Africa. Mitrović (1996) classifies the naked neck or the transylvaniaan naked neck among breeds that have combined performance traits and reports that it has been reared over a number of years in many parts of Serbia, eventually becoming a "naturalised" breed in Serbia. The initial experimental material included two strains of day-old broilers: the WNN and the autochthonous breed (that is, the BSv), most commonly reared in rural parts of Serbia. The average weight of the day-old broilers was 41.13 g for WNN and 39.47 g for BSv (Mitrović et al., 2011). Until day 28 of age, the broilers were kept in a litter housing system (about 8 birds/m^2) and fed standard mixed feeds containing 23 to 21.5% of crude proteins, that is, 3050 to 3080 kcal ME/kg. From day 28 until the end of the fattening period, the broilers were provided a free-range paddock (about 4 m^2/bird). They were fed supplementary feed including different grains, primarily made up of maize, oats, wheat and certain triticale cultivars. Brood eggs were collected from a number of rural households in the Serbian uplands (the Town of Svrljig region) and incubated in the experimental laboratory of the Faculty of Agriculture, University of Belgrade. The broilers were fattened at the "DM" private rural farm (Bosnia and Herzegovina) that provided adequate semi-

Table 1. Average values and standard deviation ($x \pm S_d$) of the major slaughter traits of the strains tested.

Parameter	Sex	WNN	BSv	Significance
Live weight (g) (LW)	Male	1686.86 ± 53.51	1651.71 ± 93.19	35.15^{ns}
	Female	1487.29 ± 53.60	1472.86 ± 44.63	14.43^{ns}
	Male+ female	1587.07 ± 113.25	1562.28 ± 115.48	24.79^{ns}
Conventional processing (%)	Male	80.27 ± 0.60	80.63 ± 0.42	-0.36^{ns}
	Female	81.05 ± 0.64	80.87 ± 0.92	0.18^{ns}
	Male+ female	80.63 ± 0.75	80.74 ± 0.73	-0.11^{ns}
Ready to roast (%)	Male	71.92 ± 0.78	72.48 ± 0.73	-0.56^{ns}
	Female	73.24 ± 1.18	72.79 ± 1.08	0.45^{ns}
	Male+ female	72.54 ± 0.71	72.63 ± 1.26	-0.09^{ns}
Ready to grill (g)	Male	1030.85 ± 47.34	1020.71 ± 67.77	10.14^{ns}
	Female	928.14 ± 47.13	916.00 ± 37.45	12.14^{ns}
	Male+ female	979.50 ± 69.78	968.36 ± 75.75	11.14^{ns}
Ready to grill (%)	Male	61.11 ± 1.00	61.79 ± 0.86	-0.68^{ns}
	Female	62.40 ± 1.09	62.19 ± 0.82	0.21^{ns}
	Male+ female	61.73 ± 2.24	61.99 ± 1.14	-0.26^{ns}
Breast (%)	Male	25.31 ± 0.71	25.22 ± 0.49	0.09^{ns}
	Female	25.40 ± 0.57	25.34 ± 0.63	0.06^{ns}
	Male+ female	25.35 ± 0.64	25.28 ± 0.56	0.07^{ns}
Drumstick + thighs (%)	Male	34.38 ± 0.53	34.15 ± 0.61	0.23^{ns}
	Female	34.21 ± 0.57	33.71 ± 0.56	0.50*
	Male+ female	34.29 ± 0.56	33.93 ± 0.37	0.36*
Back + pelvis (%)	Male	26.56 ± 0.47	26.83 ± 0.79	-0.27^{ns}
	Female	26.11 ± 0.66	27.11 ± 0.69	-1.00**
	Male+ female	26.34 ± 0.62	26.97 ± 0.75	-0.63**
Wing (%)	Male	13.74 ± 0.34	13.79 ± 0.20	-0.05ns
	Female	14.27 ± 0.57	13.84 ± 0.29	0.43*
	Male+ female	14.01 ± 0.54	13.81 ± 0.21	0.20^{ns}

**P<0.05; **P<0.01; ***P<0.001.* ns, not significant; WNN, White Naked Neck; BSv, Black Svrljig strain.

intensive rearing conditions for the test broilers. At the end of the semi-intensive fattening period (day 84), a total of 56 broilers of both sexes (28 WNN and 28 BSv) were randomly selected, individually weighed (to obtain live weight; LW), slaughtered and analysed for the following parameters: carcass weight (g): conventional processing (CP), ready to roast (RR) and ready to grill (RG), carcass yield (%): conventional processing (CP), ready to roast (RR) and ready to grill (RG), yields of breast: B (pectoral muscles with bone and skin), drumsticks + thighs: D+T (muscles including the bones which surround the femur, tibotarsus and fibula just ahead of the metatarsus), back + pelvis: B+P (the region of the thoracic, synsacral till coccygeal vertebrae), wings (W), head (H), feet (F), neck: N (muscles surrounding the region of the cervical vertebrae just behind the atlas vertebrae and ahead of the first thoracic vertebrae), giblets: G (heart, liver and gizzard) and abdominal fat (AF). Carcass yield and yield components was calculated using the following formulae: (CP/LW) x 100; (RR/LW) x 100; (RG/LW) x 100; (B/RG) x 100; (D+T/RG) x 100; (B+P/RG) x 100; (W/RG) x 100; (H/CP) x 100; (F/CP) x 100; (N/CP) x 100; (G/CP) x 100 and (AF/CP) x 100.

The data collected were subjected to a two-way analysis of variance using the general linear model:

$$Y_{ijk} = \mu + (St)_i + (Se)_j + (StSe)_{ij} + E_{ijk}$$

Where, Y_{ijk} is the individual measurement for each bird, μ is the overall mean, $(St)_i$ is the effect of the i^{th} strain, $(Se)_j$ is the effect of the j^{th} sex, $(StSe)_{ij}$ is the interaction effect of strain and sex, and E_{ijk} is the random error. The significant differences determined by the analysis of variance and F_{exp} results were evaluated using the Tukey test.

RESULTS AND DISCUSSION

The average values and variability of live weight, carcass yield and yields of primal carcass cuts of both broiler strains (the White Naked Neck and the Black Svrljig) of both sexes after 84 days of fattening are given in Table 1. Both sexes of the White Naked Neck broilers had 26 g higher body weight at slaughter as compared to the Black Svrljig strain, but the difference was not significant (P>0.05) (Table 1). The effect of genotype (strain) on carcass weight and yield of breast and wings was not statistically significant, whereas the carcasses of the White Naked Neck gave a significantly (P<0.05) higher drumstick + thigh yield and a lower back + pelvis yield as compared to the Black Svrljig (34.29 to 33.93% and 26.34 - 26.97%, respectively), (P<0.01). Similar findings were obtained by

Table 2. Average values and standard deviation ($x \pm S_d$) of the major slaughter traits of male and female broilers of both strains.

Parameter	Male	Female	Significance
Live weight (g)	1669.29 ± 77.99	1480.07 ± 49.85	189.22***
Conventional processing (g)	1342.86 ± 66.66	1198.28 ± 48.98	144.58***
Conventional processing (%)	80.44 ± 0.58	80.96 ± 0.75	-0.52*
Ready to roast (g)	1205.14 ± 66.32	1080.71 ± 50.90	124.43***
Ready to roast (%)	72.19 ± 0.84	73.02 ± 1.10	-0.83**
Ready to grill (g)	1025.78 ± 58.67	922.07 ± 42.99	103.71***
Ready to grill (%)	61.45 ± 0.87	62.30 ± 0.82	-0.85**
Breast (%)	25.26 ± 0.61	25.37 ± 0.60	-0.11^{ns}
Drumstick + thighs (%)	34.26 ± 0.58	33.96 ± 0.36	0.30*
Back + pelvis (%)	26.69 ± 0.66	26.61 ± 0.84	0.08^{ns}
Wing (%)	13.76 ± 0.28	14.06 ± 0.46	-0.30**

*$P<0.05$; **$P<0.01$; ***$P<0.001$. ns, not significant.

Faria et al. (2010) in a fattening trial lasting 85 days under a semi-extensive system involving two strains of broilers (P. Peledo and P. Pedres). The authors reported the effect of genotype and sex on live body weight at slaughter, carcass weight and carcass yield (%). Body weight at slaughter and carcass weight of both strains were 2806.7 to 2115.0 g in males and 2218.3 to 1665.0 g in females, respectively. Carcass yield (%) was 77.09% (males) and 75.65% (females) in P. Peledo, and 73.75% (males) and 74.43% (females) in P. Pedres. These findings were confirmed by the results of Souza (2004), Takahashi et al. (2006), Coelho et al. (2007), Grashorn and Clostermann (2002), Van Marle-Köster and Webb (2000), and Blagojević et al. (2009) in different genotypes, that is, in broilers of different slaughter ages under different rearing systems. Interesting studies were conducted by Castellini et al. (2002), Grashorn (2006) and Lichovníková et al. (2009), who provided a comparative analysis of slaughter results in slow and fast-growing male broilers (fast-growing Ross and Hubbard JV; slow-growing Isa S, Isa J and Isabrown) fed under different systems until they attained different ages (56, 81, 84 and 90 days). Slow-growing strains of broilers had statistically significant ($P<0.05$) lower body weight at slaughter and carcass yield as compared to fast-growing broiler strains, which was as expected given the two (heavy and light) hybrid types. Additionally, primal carcass cuts (breast, thigh and drumstick) were significantly affected by (conventional and organic) rearing systems and length of the fattening period. Pavlovski et al. (2009) studied the carcass characteristics of Naked Neck (NN) and French Naked Neck Farm Q (FQ) broilers fed until 91 and 98 days of age. However, by employing a longer fattening period and an extensive rearing system, their results were somewhat similar to those of this study. The average body weight at slaughter in both male and female broilers was 1371.0 g (FQ) and 1295.0 g (NN). Carcass yield was within the following range: 79.4% (FQ) to 75.4% (NN) for "traditionally dressed carcass", 72.4% (FQ) to 68.1% (NN) for "ready to cook" and 62.6% (FQ) to 58.7% (NN) for "ready to grill" carcass. Nevertheless, slaughter yield (%) was statistically and significantly affected ($P<0.01$) by genotype, but was not ($P>0.05$) by sex. A somewhat higher carcass yield under an equally extensive rearing system during a shorter fattening trial (84 days) was reported by Blagojević et al. (2009).

As confirmed to some extent by the results of this study, it is suggested that slaughter traits are affected not only by genotype and rearing system, but also by sex (Table 2). Male broilers had significantly ($P<0.001$) higher live weight at slaughter (day 84) than females (1669.29 g to 1480.07 g, respectively) and higher carcass yield (g). Conversely, slaughter yield, that is, carcass percentage (%) relative to the weight before slaughter was statistically and significantly higher ($P<0.05$; $P<0.01$) in female broilers (Table 2). As compared to male broilers, breast and wing yields in females were statistically and significantly higher by 0.11 and 0.30%, respectively ($P<0.01$). Females gave a 0.30% lower drumstick + thigh yield ($P<0.05$) than male broilers. A similar study on two strains of broilers (P. Pedres and P. Pelado) was conducted by Faria et al. (2010) who obtained similar results through identification of the effect of sex on the yield (%) of breast, drumsticks, thighs, wings and back. At 85 days of age, yield of breast and drumsticks was 25.21 and 14.17% in males and 26.84 and 13.04% in females, respectively, with the thigh yield being almost identical, averaging as 16.87%. The yield of back was 18.12% (males) and 18.63% (females), and that of wings was 11.00% (males) and 11.20% (females). Under free range rearing of broilers (Naked-Necked New Hampshire and Naked-Necked Plymouth) during a somewhat longer feeding trial (98 days), Kőrösi et al. (2000) also obtained a higher breast yield and a lower drumstick + thigh yield in females than in males. However, a few of the other

Table 3. Average values and standard deviation ($x \pm S_d$) of the yield of some carcass cuts, giblets and abdominal fat (%).

Parameter	Sex	WNN	BSv	Significance
Conventional processing (g)	Male	1354.00 ± 46.79	1331.71 ± 80.25	22.29^{ns}
	Female	1205.43 ± 47.88	1191.14 ± 49.03	14.29^{ns}
	Male+ female	1279.71 ± 88.08	1261.42 ± 96.75	18.29^{ns}
Head (%)	Male	5.71 ± 0.20	4.54 ± 0.16	1.17***
	Female	4.40 ± 0.20	4.37 ± 0.25	0.03^{ns}
	Male+ female	5.06 ± 0.67	4.45 ± 0.23	0.61***
Feet (%)	Male	5.51 ± 0.15	5.26 ± 0.24	0.25**
	Female	4.85 ± 0.25	5.27 ± 0.10	-0.42***
	Male+ female	5.18 ± 0.39	5.26 ± 0.18	-0.08^{ns}
Neck (%)	Male	5.93 ± 0.19	5.74 ± 0.28	0.19^{ns}
	Female	5.89 ± 0.17	5.70 ± 0.31	0.19^{ns}
	Male+ female	5.91 ± 0.18	5.72 ± 0.27	0.19*
Giblets (%)	Male	6.46 ± 0.07	6.46 ± 0.12	/
	Female	6.32 ± 0.11	6.30 ± 0.15	0.02^{ns}
	Male+ female	6.39 ± 0.11	6.38 ± 0.15	0.01^{ns}
Abdominal fat (%)	Male	1.07 ± 0.09	1.06 ± 0.08	0.01^{ns}
	Female	1.16 ± 0.12	1.10 ± 0.08	0.06^{ns}
	Male+ female	1.12 ± 0.11	1.08 ± 0.08	0.04^{ns}

**P<0.05; **P<0.01; ***P<0.001.* ns, not significant; WNN, White Naked Neck; BSv, Black Svrljig strain.

Table 4. Average values and standard deviation ($x \pm S_d$) of some carcass cuts, giblets and abdominal fat in male and female broilers of both strains.

Parameter	Male	Female	Significance
Conventional processing (g)	1342.86 ± 66.66	1198.28 ± 48.98	144.58***
Head (%)	5.13 ± 0.61	4.39 ± 0.23	0.74***
Feet (%)	5.39 ± 0.24	5.06 ± 0.29	0.33***
Neck (%)	5.84 ± 0.22	5.79 ± 0.27	0.05^{ns}
Giblets (%)	6.46 ± 0.10	6.31 ± 0.13	0.15**
Abdominal fat (%)	1.07 ± 0.09	1.13 ± 0.10	-0.06*

**P<0.05; **P<0.01; ***P<0.001.* ns, not significant.

cited authors reported similar or even slightly higher carcass yields in males than in females. The relative yield of other carcass cuts, giblets and abdominal fat relative to the live weight of male and female broilers of both strains tested is given in Tables 3 and 4. Both male and female broilers of the White Naked Neck as compared to the Black Svrljig had a statistically significant (P<0.01) higher yield of the head, but a lower yield of the neck (P<0.05). The feet, giblet and abdominal fat yields were almost identical in the two broiler strains. As opposed to the genotype effect, the effect of sex on the test parameters was significantly higher (Table 4). Male broilers of both strains, as compared to females, had a statistically significant (P<0.01; P<0.05) higher yield of the head, feet and giblet, and a lower yield of abdominal fat (P<0.05), with the neck yield being almost identical (about 5.8%); although, the difference (0.05%) was statistically non-significant (P>0.05). Under semi-extensive rearing conditions in a fattening trial lasting until 85 days of broiler age, a considerably higher yield of the neck (8.17% - both sexes) and abdominal fat (2.40% - both sexes), a similar feet yield (5.39% - males; 4.73% - females), and a considerably lower giblet yield (5.96% - both sexes) in two native strains were obtained by Faria et al. (2010). A similar yield of abdominal fat (about 1%), with females gaining higher values than males, in slow-growing strains of native broilers under semi-intensive, semi-extensive or organic rearing systems was reported by Kőrösi et al. (2000), Castellini et al. (2002), Grashorn (2006), Lichovníková et al. (2009), Pavlovski et al. (2009) and Bogosavljević-Bošković et al. (2010). Blagojević et al. (2009) obtained a somewhat higher yield of abdominal fat in two slow-growing and two fast-growing hybrids at 84 days of age under an extensive rearing system, where the relative yield of abdominal fat ranged from 1.46 to 3.16% (both sexes).

Conclusion

The analysis of the slaughter traits of two native strains (White Naked Neck and Black Svrljig) of broilers reared under a semi-intensive system in a fattening trial until 84 days of age suggests that the test strains, both in the Republic of Serbia and in the surrounding region, showed satisfactory performance in terms of the parameters tested, due to which they can be successfully used in the semi-intensive rearing system towards the production of quality organic broiler meat in accordance with EU laws and standards on organic livestock production.

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