Original paper

COMPARATIVE STUDIES ON THE REPRODUCTIVE AND PRODUCTIVE TRAITS OF NEW HAMPSHIRE AND SOMBOR CRESTED CHICKEN BREEDS REARED IN SEMI-EXTENSIVE PRODUCTION SYSTEM

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Abstract

Research was conducted on New Hampshire (in further text NH) and Sombor Crested (in further text SC) breeds which were kept in semi extensive system. 56 birds of each breed were used (50 females and 6 males) in the experiment. 100 eggs from every chicken breed were used for natural hatching, and remained eggs were sold. From the total number of the naturally incubated eggs, 83 (NH) and 85 (SC) chickens were hatched, and they were used for the study of performance and related parameters.

Eggs and chickens originating from NH breed were statistically significantly heavier ($P<0.001$; $P<0.01$) compared with SC breed. Egg shape index and chicken percentage in egg weight were significantly higher at SC ($P<0.001$; $P<0.05$) compared to NH breed. Very strong positive correlation was determined between egg weight and chicken weight in both breeds. Very weak negative correlation was determined between egg weight and relative chicken intake in the egg weight. Similarly, between egg shape index and chicken weight, negative correlation coefficient was determined in both breeds. However, between egg shape index and chicken percentage, statistically significant ($P<0.001$) negative correlation coefficient was determined in NH breed. Significant ($P<0.05$) positive correlation for the same performances was determined in SC breed.

Key words: *New Hampshire (NH) breed, reproductive parameters, semi-extensive system, Sombor Crested (SC) breed*

Introduction

Based on available literature it can be noted that productive and reproductive performances of pure breeds and their mestizos have nowadays become subjects of research for economic reasons. This is particularly important regarding the adoption of the Law on organic animal husbandry (EU, EEC-Regulation 1804/1999 – supplementing regulation no. 2092/91), respectively animal production, which attaches more importance to pure races because they are more convenient for the organic poultry meat and eggs than some chicken hybrids.

In semi extensive or extensive breeding system, following breeds are being reared in the Republic of Serbia: New Hampshire, Naked Neck, White Leghorn, Rode Island Red, and two domestic breeds Black Svrljig and Sombor Crested. Research was conducted with the

goal to determine productivity of these breeds in semi extensive breeding system (Mašić et al., 1970; Žigić et al., 1970; Marinković et al., 1972; Apostolov, 1976; Apostolov N. and Apostolov D, 1976). Thorough researches, in order to determine fattening and slaughter parameters of above mentioned breeds reared in different breeding systems, were conducted by many authors (Milošević et al., 2005; Pavlovski et al., 2009; Mitrović et al., 2011a). Besides, incubation values of eggs originating from two chicken breeds (strains) (White Naked Neck - WNN and Black Svrljig strain - BSv) which were reared in rural parts of Serbia in extensive breeding systems were conducted in a lesser extent (Mitrović et al., 2011b).

Next to incubation parameter results, researching of physical egg parameters and their influence on incubation values highly contributes to poultry production and reproduction of different breeds and poultry genotypes (Farooq et al., 2001; Islam et al. 2002a and 2002b; Witt and Schwalbach, 2004).

It is well known that egg weight influences the chicken weight and chicken percentage in total egg weight. Similar statement was confirmed for different genotypes of parental flocks by majority of researchers (Luquetti et al., 2004; Vieira et al., 2005; Almeida et al., 2006; Miclea and Zahan, 2006; Enting et al., 2007; Wolanski et al., 2007; Đermanović, 2010; Đermanović et al., 2010). The highest relative share of chicken in egg weight was determined in 27 weeks old parents, and the lowest in 60 weeks old parents. Phenotype correlation among monitored parameters of hybrids was similar for pure breeds (Farooq et al., 2001; Islam et al. 2002a and 2002b). However, between age of parents and egg weight, egg weight and chick weight, positive phenotype correlation was determined, but between egg weight and percentage of the chicken in egg weight negative correlation was determined and it had different levels of significance.

Bearing in mind that New Hampshire and Sombor Crested breeds are being reared in significant extent in Serbia, the aim of this research was a comparative analysis of productive and reproductive traits of the above mentioned breeds. Basically, laying intensity in specific time frame, egg weight, phenotype quality characteristics of eggs (length, width and shape index), hatched chickens weight and relative chicken weight share in total egg weight were studied. Phenotype correlation coefficients and their correlation strength were determined among the most of the following parameters.

Material and methods

With the goal to determine productive and reproductive parameters for NH and SC breeds the analysis of their reproductive traits while being reared in semi extensive system was conducted. Two parental flocks were used as experimental material. Within each breed there were 50 female and 6 male birds (1♂ : 8♀), which were individually marked by leg rings. Both parental flocks were reared separately near the farmer house and were fed, besides natural pasture, with corn grain, corn grout, and wheat and concentrate mixtures. The experiment lasted 60 days. Productivity of both breeds was monitored, respectively; number of laid eggs was counted each day for each breed and each hen during that period. Based on that laying the intensity, (absolute and relative), was calculated. Moreover, weight of each egg was taken just after being laid, length and width were also measured and the shape index was calculated for each laid egg.

For reproduction of both chicken breeds, 100 eggs were chosen by random sample method and they were planted under the hens in specific time intervals. All eggs were marked with specific number which was written on the egg shell. Identity of each chick was easily

determined that way. Eggs which were not used for reproduction, as surplus were used as consumable eggs at the farm or at the market as eggs for incubation. Chicks were laid naturally using the brooding hens and for that purpose from each breed seven hens were used.

During the experimental period following parameters were determined: number of laid eggs, laying intensity [(number of eggs/60 days) x 100], laid eggs weight, length and width of laid eggs, egg shape index [Shape index = (width/length) x 100], egg weight before planting under the broody hen, weight of hatched chickens and relative share of the chicken in the egg weight [(chick weight/egg weight) x 100]. Besides, not fertilized eggs were measured as well as their length and width, and shape index was calculated.

Usual statistic parameters were calculated for all productive and reproductive parameters: arithmetic mean, arithmetic mean error, standard deviation, and variation coefficient. Determined differences between followed parameters were calculated by t-test. Phenotype correlation coefficients and correlation between egg weight (fertilized and not fertilized) and phenotype egg parameters (length, width, and egg shape index), were calculated with statistic program (SAS, 2000) as well as correlation between weight of incubation eggs and one day old chickens and chicken share in total egg weight.

Results and discussion

It has already been mentioned that for natural hatching (by using the hen) 100 eggs were used for each breed and 83 day old chicks of NH breed and 85 chicks from SC breed were hatched. Hatchability for NH was 83.00% and 85.00% for SC. However, some authors (Mitrović et al., 2011b) determined significantly lower hatchability for BSv (78.02%) and WNN (80.00%), while eggs of RIR, BPR, WLH and WR during artificial incubation (Witt and Schwalbach, 2004) determined lower hatchability of 88.16% and 95.08%.

Both studied breeds produced totally 3,699 eggs out of which 200 (100 – NH and 100 – SC) were used for natural hatching (research), while 3,499 were used for consummation. For given period NH parental flock produced totally 1,799 eggs (laying intensity 59.97%), while SC flock produced 1,850 eggs (laying intensity 61.67%). Obtained results are shown in Table 1.

Table 1. *Average value, variability and significant difference between observed parameters in analyzed race of chicken*

Parameters	Breed	n	Mean	SEM	SD	C.V.	Significance
Hatching eggs							
Eggs weight, g	NH	100	58.99	0.44	4.48	7.85	1.95***
	SC	100	57.04	0.34	3.45	6.05	
Eggs length, cm	NH	100	5.91	0.02	0.23	3.89	0.34***
	SC	100	5.57	0.02	0.16	2.87	
Eggs width, cm	NH	100	4.36	0.01	0.13	2.98	0.09***
	SC	100	4.27	0.01	0.09	2.11	
Egg shape index, %	NH	100	73.77	0.30	3.02	4.09	-2.84***
	SC	100	76.61	0.11	1.06	1.38	
Fertilized eggs							
Eggs weight, g	NH	83	59.48	0.49	4.48	7.53	2.63***
	SC	85	56.85	0.37	3.43	6.03	

Eggs length, cm	NH	83	5.93	0.02	0.22	3.71	0.36***
	SC	85	5.57	0.02	0.16	2.87	
Eggs width, cm	NH	83	4.37	0.01	0.13	2.97	0.10***
	SC	85	4.27	0.01	0.09	2.11	
Egg shape index, %	NH	83	73.80	0.32	2.89	3.92	-2.80***
	SC	85	76.60	0.12	1.11	1.45	
1-day-old chickens							
Chick weight, g	NH	83	42.23	0.36	3.30	7.81	1.31**
	SC	85	40.92	0.23	2.15	5.25	
Chick weight, %	NH	83	71.01	0.22	2.04	2.87	-1.03*
	SC	85	72.04	0.20	1.83	2.54	
Not fertilized eggs							
Eggs weight, g	NH	17	56.59	1.15	4.75	8.40	-1.54^{ns}
	SC	15	58.13	0.86	3.32	5.71	
Eggs length, cm	NH	17	5.85	0.07	0.28	4.79	0.25**
	SC	15	5.60	0.04	0.15	2.68	
Eggs width, cm	NH	17	4.30	0.03	0.11	2.56	0.01^{ns}
	SC	15	4.29	0.02	0.09	2.11	
Egg shape index, %	NH	17	73.61	0.89	3.68	5.00	-3.07**
	SC	15	76.68	0.45	1.74	2.27	

*P < 0.05; **P < 0.01; ***P < 0.001; ^{ns}-no significance.

NH breed average weight of laid eggs was 58.99 g, hatched eggs (fertilized) 59.48 g and not fertilized 56.59 g, while for SC breed average weight of laid eggs was 57.04 g, hatched (fertilized) eggs 56.85 g and 58.13 g for not fertilized eggs. Weight of eggs (hatching and fertilized) coming from NH breed was significantly higher (P<0.001) than eggs from SC breed, while weight of not fertilized eggs was higher for SC breed though it was not statistically significant (P>0.05). It can be seen from Table 1 that all eggs from SC breed had statistically significantly (P<0.001; P<0.01) higher (76.61%; 76.60%; 76.68%) shape index (width length ratio, %) compared to eggs coming from NH breed (73.77%; 73.80%; 73.61%). Average chicken weight for NH breed was 42.23 g, while for SC breed 40.92 g, therefore chickens coming from NH breed had statistically significantly (P<0.01) higher body weight by 1.31 g than chickens coming from SC breed (Table 1). Chicken share in weight of an egg was higher in SC breed (72.04%) than in NH breeds (71.01%), and difference was statistically significant (P<0.05).

Regarding the eggs weight for NH breed (58.29 g – 58.36 g) and shape index (72.86%), some authors (Mašić et al., 1970; Žigić et al., 1970) obtained similar results. However, in eggs of the White Rock breed (Mašić et al., 1970) higher egg weight was determined being between 61.03 g and 61.32 g, while for the same chick breed (Marinković et al., 1972; Apostolov, 1976) in similar breeding conditions lower egg weight was determined (57.18 g) and slightly higher shape index value (74.70%). Authors (Farooq et al., 2001; Islam et al., 2002a and 2002b; Mitrović et al., 2011b) determined the highest egg weight 61.27 g (Mitrović et al., 2011b), slightly lower in White Leghorn 59.48 g (Islam et al., 2002a and 2002b), and lowest egg weight in Rhode Island Red 53.94 g (Farooq et al., 2001), while the shape index was 1.33 [(width/length) x 100 = 75.19%].

During the reproductive parameters research attention is given to the quality of hatched chickens, to the relative share of the chicken in egg weight. During determination of the mentioned parameter different results were obtained, more than 70% (Witt and Schwalbach, 2004) and between 65.96% and 68.43% (Apostolov N. and Apostolov D., 1976; Islam et al., 2002a; Mitrović et al., 2011b).

Based on obtained results it can be noticed that egg weight had some influence on all monitored productive and reproductive parameters for both studied breeds (NH and SC). This statement is best ratified by calculated phenotype correlation coefficients between monitored parameters (Table 2).

Table 2. *Phenotype correlation coefficients for the studied parameters of the analyzed chicken breeds (New Hampshire, n = 83; Sombor Crested, n = 85)*

Param.	Breed	E.We.	E.L.	E.Wi.	E.S.I.	C.We. (g)	C.We. (%)
E.We.	NH	1.000	0.593^{***}	0.734^{***}	-0.011^{ns}	0.863^{***}	-0.084^{ns}
	SC	1.000	0.722^{***}	0.602^{***}	-0.241^{*}	0.787^{***}	-0.124^{ns}
E.L.	NH	-	1.000	0.557^{***}	-0.643^{***}	0.606^{***}	0.112^{ns}
	SC	-	1.000	0.801^{***}	-0.623^{***}	0.565^{***}	-0.281^{*}
E.Wi.	NH	-	-	1.000	0.281^{*}	0.611^{***}	-0.271^{*}
	SC	-	-	1.000	-0.033^{ns}	0.401^{***}	-0.186^{ns}
E.S.I.	NH	-	-	-	1.000	-0.130^{ns}	-0.380^{***}
	SC	-	-	-	1.000	-0.300^{**}	0.221^{*}
C.We. (g)	NH	-	-	-	-	1.000	0.300^{**}
	SC	-	-	-	-	1.000	0.251^{*}
C.We. (%)	NH	-	-	-	-	-	1.000
	SC	-	-	-	-	-	1.000

E.We. - Eggs weight (g); E.L. - Eggs length (cm); E.Wi. - Eggs width (cm); E.S.I. - Egg shape index (%); C.We. - Chick weight (g); C.We. (%) - Chick weight (%); *P < 0.05; **P < 0.01; ***P < 0.001; ^{ns}-no significance

Data from Table 2 show that by incubation eggs weight increasing the length, width and chicken weight were increased for both breeds statistically significantly (P<0.001), and very strong correlation was determined. Between eggs weight, shape index and chicken share in weight of an egg negative coefficients were determined for both breeds though they were not statistically significant (P>0.05), except for the egg weight and shape index correlation where phenotype correlation (r_p=-0.241) was calculated and it was statistically significant (P<0.05).

By determining correlation of studied parameters between different genotypes most of the authors (Farooq et al., 2001; Islam et al., 2002a and 2002b; Mitrović et al., 2011b) came to similar conclusion. Similar correlation values between egg weight, length and width (P<0.05) were determined for Rhode Island Red (Farooq et al., 2001; Islam et al., 2002a and 2002b; Mitrović et al., 2011b), as well as between egg weight and one day old chick weight (r_p=0.496). However, WNN and BSv strain (Mitrović et al., 2011b) had statistically positive phenotype correlation between egg weight and chick weight (P<0.001). Between egg weight and relative chick share in egg weight (Mitrović et al., 2011b) negative correlation was determined (r_p=-0.204) for WNN, while for BSv it was positive (r_p=0.058), where correlation coefficients were not statistically significant (P>0.05).

Many authors (Luquetti et al., 2004; Vieira et al., 2005; Almeida et al., 2006; Miclea and Zahan, 2006; Enting et al., 2007; Đermanović, 2010; Đermanović et al., 2010) concluded that age of parents influences the egg weight, that egg weight influences the hatched chick weight and percentage of the chicken in the egg weight for hybrids Ross SL 2000, Ross 308 and Cobb 500. Quoted authors state that with the age of broiler parents egg weight increases, and that with increase of the egg weight chicken weight increases as well as dynamics of egg weight loss during the incubation period (positive phenotype correlation

was determined), but percent of the chick in the egg weight decreases (negative correlation).

Finally it can be said that research results of quoted authors for pure breeds and hybrids during artificial incubation mainly match up with productive and reproductive traits of NH and SC breeds during natural egg incubation.

Conclusion

Conducted research and obtained results show that NH and SC while being kept in semi extensive breeding system show satisfying productive and reproductive traits, and that both breeds can be used in organic poultry production. Moreover, research results point that during the natural hatching compared to artificial incubation, better results were obtained, especially regarding hatchability percentage and relative share of the chicken in total egg weight.

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