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Phenotype correlation of external and incubation traits of Italian White Goose eggs and goslings after hatching

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ABSTRACT

Based on observations and established results related to reproduction characteristics, i.e. physical and incubation values of the Italian White Goose, following conclusions were drawn: out of 400 incubated eggs, 352 were fertilised (88.00%); 316 goslings were hatched (79% and 89.77% out of the number of inlaid and the number of fertilised eggs respectively); while the mortality during the incubation period (early, medium and late) amounted to 36 dead embryos (9.00% and 11.39% out of the number of incubated and the number of fertilised eggs respectively). Furthermore, following correlation was established by calculating the coefficients of phenotype correlation between major traits: very weak – between egg weight and egg shape index (r_p = 0.180**); absolute – between egg weight and hatching weight of goslings (r_p = 0.986***); medium – between egg weight and gosling percentage in the egg weight (r_p = 0.477***); weak – between egg shape index and gosling weight (r_p = 0.195***); while between the egg shape index and the gosling percentage in the egg weight no statistically significant (P>0.05) correlation was established ($r_p = 0.031^{NS}$).

Key words: Correlation, Egg weight, Egg shape index, Geese, Gosling weight.

INTRODUCTION

In general, embryonic development of young birds, including poultry, apart from the genetic potential (basis) also depends on a variety of non-genetic factors. Physical (external) and structural (internal) egg characteristics are some of the most important of these factors. Special importance is given to weight and size, as well as the egg shape index, which are the factors which (to various degrees) directly affect successful hatching of incubated eggs, i.e., production of offspring of different types of poultry (Whiting and Pesti, 1983, Shanawany, 1984, Yannakopoulos and Tserveni-Gousi, 1987; Puchajda *et al*.,1988; Altan *et al.,* 1995; Mitrovic *et al*., 1996; Baspinar *et al*., 1997; Kirmizibayrak *et al.*, 2001; Saatci *et al.*, 2005; Moran, 2007; Đermanović *et al.,* 2008; Mitrovic *et al.,* 2010; Đemanović *et al.*, 2016).

In this context, Whiting and Pesti (1983), Shanawany (1984), Yannakopoulos and Tserveni-Gousi (1987), Skewes *et al.* (1988), Altan *et al.* (1995), Raju *et al.* (1997) i Ksiazkiewicz *et al.* (1998) report that egg weight and egg shape index have effect on incubation results and subsequently on the weight of hatched offspring of different types of poultry (chicken, ducks, quails).

Puchajda *et al*. (1988), Willin (1995), Saatci *et al.* (2005) and Đermanović *et al*. (2008) reported positive correlation between egg weight and gosling weight in different goose breeds, strains and mongrels (Bilgoraj goose, various strains (by feather color) of Turkish domestic goose, two-breed mongrel geese etc.). Đermanović *et al.* (2008) reported statistically significant absolute correlation (rp = 0.987***) between the egg mass before laying into incubator and the mass of one day old goslings of two-breed mongrel geese. Average egg mass was 150.79 g and the average weight of one day goslings was 103.07g.

It should be taken into consideration that the reproductive potential of geese and ducks is significantly lower than that of the chicken, primarily because the number of eggs they produce during the production cycle is considerably lower, and because the mortality of their embryos during the incubation is considerably higher (Rosinski and Bednarczyk, 1997).

It is evident that the data related to results of goose egg incubation, and effects of various genetic and non-genetic factors on the goose reproduction is scarce in international, and particularly in domestic literature. For this reason, the primary aim of this research was to investigate effects of egg weight and shape index on incubation results (egg fertilisation, egg weight on day 25, egg mass loss during the incubation period, embryo mortality, gosling weight), as well as the correlation between examined traits of the Italian White Goose.

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MATERIALS AND METHODS

Family farm "Anser" is located in the village Triješnjica, 10 km away from Bijeljina, the second largest city of Republica Srpska. The primary economic activity of this farm is breeding Italian White Geese, i.e. production of eggs for breeding and one day old goslings, as the final product. The farm disposes of 2000 male and female individual birds which is considered to be a fairly large parent flock of the Italian White Goose. The farm has an adequate number of housing installations for the geese to use at night and during the periods of bad weather, while the rest of time they spend outdoors with the abundance of grass for grazing so the need for additional feeding is moderate (consisting mostly of cereal grains).

In addition to daily monitoring of the productive and reproductive indicators of the parent flock of geese, an experiment was carried out at this farm with the purpose of getting a deeper insight into genetic potentials of the Italian White Goose. Particular importance was attached to effects of egg weight and shape index on incubation results and the quality of goslings upon hatching. During the months of February and March a total of 400 eggs were randomly selected and incubated within the same period.

During the incubation period following parameters were determined: number and percentage of fertilised eggs and the number and percentage of hatched goslings out of the number of incubated and fertilised eggs. Each egg was weighed and measured individually, marked on egg shells with pencil and disinfected with formaldehyde vapor, before being laid into incubator. Egg mass, width and length were measured individually, as well as the mass of goslings, immediately after the hatching and drying.

Before transferring eggs from setting to hatching trays (day 25 of incubation) fertilisation of eggs was determined and the percentage of fertilised eggs out of the number of eggs laid was calculated. Furthermore, hatching tray frames were divided to facilitate individual placement of eggs and subsequent hatching of goslings. This allowed the researchers to be certain which gosling hatched from which egg, and thus facilitated the calculation of the correlation between certain traits and goslings. Embryo mortality was also monitored during egg incubation: early (days 1 to 6), medium (days 7 to 25) and late mortality (days 26 to 31). The number and the percentage of hatched goslings out of the number of laid and fertilised eggs was calculated at the end of the incubation period.

Based on these measurements average egg mass before laying into the incubator was established, as well as egg width and length, based on which egg shape index (ESI) was calculated according to the following formula:

$$ESI = \frac{\text{egg width (cm)}}{\text{egg length (cm)}} \times 100$$

The mass of one day old goslings was calculated at the end of incubation period. Based on egg mass before incubation and the mass of hatched goslings, percentage of goslings in the egg mass was calculated (%GEM):

$$\%GEM = \frac{\text{egg mass (g)}}{\text{one-day old gosling (g)}} \times 100$$

Basic data processing was carried out by implementing the usual statistical variance methods, i.e. elementary indicators of descriptive statistics were calculated: arithmetic mean ($\bar{x}$); arithmetic mean error ($S\bar{x}$), standard deviation (SD) and variance coefficient (VC). Furthermore, simple variance analysis (three treatments) with unequal number of repetitions was applied to established difference significances between different egg classes (hatched eggs, eggs with dead embryos and non-fertilised eggs) regarding observed traits, and they were evaluated by using the Tukey test. Correlation coefficients (r_p) between observed traits were calculated and their level of significance was evaluated (Snedecor and Cochran, 1970).

RESULTS AND DISCUSSION

For this experiment, 400 Italian White Goose eggs were used, incubated in two sequences – in February and March (200 eggs per each sequence). In general, Italian White Goose eggs demonstrated satisfactory incubation values, particularly in terms of gosling hatchability, both in relation to the number of laid and to the number of fertilised eggs.

Out of a total of 400 eggs, 352 were fertilised (88.00% fertilised eggs out of the number of incubated eggs), and 316 goslings were hatched. Hatchability of goslings out of the number of incubated and fertilised eggs was 79.00% and 89.77% respectively. There were 48 non-fertilised eggs or 12.00%, and 36 eggs with dead embryos or 9% out of the number of incubated eggs (10.23% out of the number of fertilised eggs). Late embryo mortality was dominant – 5.00% (out of incubated eggs) and 5.68% (out of fertilised eggs); medium was considerably lower – 2.50% and 2.84%; while the late mortality was least significant – 1.50% and 1.70%.

Of all egg groups, particular attention was paid to hatched eggs category. Mean values and variability of physical (external) characteristics of all groups of eggs are given in Table 1.

Data in Table 1 show that eggs with the largest mass before incubation were those with dead embryos (175.92), followed by eggs with hatched goslings (168.91 g), while non-fertilised eggs showed the lowest egg mass (167.08 g). Average mass of all eggs was 169.32 g. In comparison with hatched and non-fertilised eggs, eggs with dead embryos had statistically significantly larger mass at $P<0.01$ and $P<0.001$. However, relative share of the egg mass on 25th day of

Table 1: Mean values and variability of incubated eggs of different categories

Egg traits	N	$\bar{x}$	$S\bar{x}$	SD	VC
		All incubated eggs			
Egg mass on 1st day	400	169.32	0.92	18.35	10.84
Egg mass on 25th day	400	150.89	0.67	13.35	8.85
Egg percentage on 25th day	400	89.07	0.11	2.25	2.53
Egg width (cm)	400	5.84	0.01	0.29	4.97
Egg length (cm)	400	8.93	0.02	0.39	4.37
Shape index (%)	400	65.42	0.12	2.45	3.74
		Hatched eggs			
Egg mass on 1st day	316	168.91	0.95	16.91	10.01
Egg mass on 25th day	316	149.89	0.55	9.84	6.56
Egg percentage on 25th day	316	88.70	0.12	2.17	2.45
Egg width (cm)	316	5.84	0.02	0.29	4.97
Egg length (cm)	316	8.90	0.02	0.35	3.93
Shape index (%)	316	65.62	0.13	2.24	3.41
One-day old gosling mass (g)	316	112.50	0.73	12.94	11.50
% of gosling in egg mass	316	66.51	0.11	1.96	2.95
		Non-fertilised eggs			
Egg mass on 1st day	48	167.08	3.27	22.65	13.56
Egg mass on 25th day	48	153.21	3.11	21.58	14.08
Egg percentage on 25th day	48	91.64	0.30	2.06	2.25
Egg width (cm)	48	5.78	0.04	0.30	5.19
Egg length (cm)	48	8.98	0.08	0.53	5.90
Shape index (%)	48	64.46	0.50	3.49	5.41
		Eggs with dead embryos			
Egg mass on 1st day	36	175.92	3.7	22.22	12.63
Egg mass on 25th day	36	156.55	3.58	21.46	13.71
Egg percentage on 25th day	36	88.91	0.35	2.13	2.40
Egg width (cm)	36	5.90	0.04	0.25	4.24
Egg length (cm)	36	9.09	0.08	0.49	5.39
Shape index (%)	36	64.95	0.36	2.17	3.34

incubation in the egg mass before incubation was 91.64% in case of non-fertilised eggs, 88.91% in case of hatched eggs and 89.07% of all eggs.

Hatched eggs had the highest egg shape index (65.62%), followed by eggs with dead embryos (64.95%) and non-fertilised eggs (64.46%), while egg shape index of all eggs was 65.42% (Table 1).

Average gosling mass at hatching was 112.50 g, and the relative share of the gosling in the egg mass was 64.46%. Data in Table 1 show that the absolute (SD) and relative (VC) variance measures were significantly more prominent in egg and gosling mass than in other indicators.

As stressed earlier, the hatched eggs were the most important category, for which reason the phenotype correlation coefficients were calculated between major egg traits and goslings to acquire a better insight into the genetic potential of the Italian White Goose in terms of observed indicators (Table 2).

Table 2 shows that a very weak positive correlation was established between egg weight before incubation and egg shape index (r_p = 0.180), but the coefficient was statistically significant (P<0.01). Absolute positive correlation was established between egg weight and gosling weight (r_p = 0.986***). Statistically significant (P<0.001) medium positive correlation was established between egg weight and gosling percentage in egg weight (r_p = 0.477). Very weak correlation, but statistically significant (P<0.001) was established between egg shape index and gosling weight, while no correlation (P>0.05) was established between egg shape index and gosling percentage in egg weight.

Similar and partly poorer results in mongrels obtained by reciprocal interbreeding of several goose breeds were reported by Mazanowski and Chelmonska (2000), Mazanowski and Adamski (2002), Mazanowski and Bernacki (2006). Poorer and significantly lower egg fertility and hatchability of Italian White Goose and two-breed mongrels is reported by Rosinski (2000) and Đermanović *et al.* (2008). Berdnarczyk and Rosinski (1998) established significantly lower gosling hatchability out of the number of fertilised eggs (67,3%, 65,1% and 78,5%) of two types of Italian White Goose and Kuban Goose. Similar to our results in terms of embryo mortality, Berdnarczyk and Rosinski (1999) reported predominant late (8,6% I 9,4%) in both types of white goose and medium (9,1%) embryo mortality in Kuban goose, and insignificantly lower early embryo mortality (under 8%) for all three goose types.

Table 2: Phenotype correlation of basic egg and gosling traits

Egg and gosling traits	rxy	Significance	Correlation strength
Egg weight - egg shape index	0.180	**	Very weak
Egg weight – gosling weight	0.986	***	Absolute
Egg weight – gosling % in egg weight	0.477	***	Medium
Egg shape index - gosling weight	0.195	***	Very weak
Egg shape index - gosling % in egg weight	0.031	NS	None

NS – P>0.05; ** - P<0.01; *** - P<0.001.

Saatci *et al.* (2005) have established in all strains (white, yellow, piebald and black) and Đermanović *et al.* (2008) in two-breed mongrels, a significantly lower egg mass (under 151 g) than in our study. Depending on the goose mongrel type, Mazanowski and Chelmonska (2000), Mazanowski et al. (2002), Mazanowski and Bernacki (2006) reported larger mean egg mass (184 g), but also significantly smaller (148 g) than that reported in our study (168.91 g). Similarly, Razmaitė *et al.* (2014) reported larger (186.69 g – 3rd year of breeding), and lower (123.40 g – 1st year of breeding) in case of Lithuanian VishtinPs Geese. Somewhat smaller egg mass of Italian White Goose (under 168 g), and significantly smaller egg mass of Kuban Goose (under 143 g) were reported by Bednarczyk and Rosinski (1999).

In relation to egg shape index, insignificantly higher index (66,19% i 67,12%) was reported by Saatci *et al.* (2005), and significantly higher (67.5%) as well as lower (64.9) were reported by Mazanowski and Chelmonska (2000), Mazanowski and Adamski (2002), Mazanowski and Bernacki (2006). Apart from results related to goose eggs, Salahuddin and Howlider (1991) as well as Halaj and Veterany (1998) reported different mean values of egg shape index in different chicken breeds and hybrids. Ksiazkiewicz *et al.* (1998) also reported different mean values of egg shape index of three different breeds of ducks, and Altan *et al.* (1995) report the same for the Japanese Quail.

Somewhat smaller average mass of hatched goslings (103.07 g) was reported by Đermanović *et al.* (2008), while Saatchi *et al.* (2005) established significantly smaller mass of one-day goslings (the largest average gosling mass was that of the white feathered strain – 98.41 g, and the smallest that of the multicolored strain (92.95 g). Same authors reported different values of the relative share of gosling in the egg mass of different strains of domestic Turkish Goose according to feather color: 64,25% (black strain) and 65,39% (white strain), which is insignificantly lower than our results (66,51%).

A considerable number of authors investigated the correlation between egg mass before incubation and the mass of hatched offspring of different types of poultry, e.g. Skewes *et al.* (1988), Altan *et al.* (1995), Shanawany (1984; 1987), Đermanović *et al.* (2008), and established statistically significant positive correlation coefficients which demonstrated medium, strong and very strong correlations. Shanawany (1984; 1987) and Đermanović *et al.* (2008) also established absolute correlation between average goose egg mass and one-day gosling mass (r_p = 0,980 i r_p = 0,987). Contrary to our results, Đermanović *et al.* (2008) reported negative correlation (r_p = –0,425*) between the egg mass before incubation and the percentage of the chicken in the egg mass.

Based on established results and various authors' research in this field, we can conclude that egg weight and egg shape index have direct or indirect effect on the quality of hatched goslings, and that most of the observed egg and gosling traits are in certain correlation, i.e. that they condition each other. For this reason, special attention should be paid to selection of eggs for breeding before incubation. This and other related studies' results should be considered to ensure maximum number of eggs per brooding goose, i.e. hatch a maximum number of quality goslings (the final product).

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