Abstract


The study was performed in 2004 in the selection farm of the Hybrid Centre of Poultry Breeding at the Agricultural Institute, Stara Zagora. Eggs from turkeys from the following lines were investigated: Super Heavy (SH), Meat Heavy (MH), Layer heavy (LH), Layer Light (LL), North Caucasian Bronze (NCB) as well as the parental UK line BIG-6.

The correlation coefficients and their statistical significance were determined for the relationships among the following traits: egg weight to yolk and shell weights, egg weight to shape, albumen and yolk indices; shell weight to yolk weight, shape, albumen and yolk indices; shape index to yolk weight, yolk index to albumen index; albumen index to yolk weight and yolk index; yolk weight to yolk index.

The observed correlations between the egg weight and yolk weight in hens from the LL, MH and SH lines were positive and statistically significant ($r=0.83$, $r=0.78$ and $r=0.68$ respectively). The egg weight exhibited the same relationship to shell weight in LH ($r=0.84$), MH ($r=0.83$) and the LL ($r=0.68$) lines ($P<0.001$). The augmentation of the shape index, the albumen index and yolk index did not result in increased egg weight. The observed correlation coefficients were negative and negligible ($P<0.05$). The increased yolk weight would result in higher shell weight in hens from the MH ($r=0.70$), the LL ($r=0.66$) ($P<0.001$) and the LH ($r=0.47$) lines ($P<0.01$). There was not a correlation between yolk weight and the yolk index in turkeys at the age of 32 weeks that suggested the performance of independent selection for these traits.

Key words: turkey, way of breeding, phenotypic correlation, egg quality characteristics

Introduction

The economical effectiveness in turkey meat production largely depends on productive qualities of parental turkey lines. Therefore, the characteristics of the principal parameters of egg productivity, the morphological traits of eggs and the correlations among them are particularly important.
Several authors (Belorechkov and Sredkova, 1986; Iposu et al., 1994; Ozcelik, 2002) use the morphological traits of eggs and the existing correlations among them for improving egg productivity and quality in poultry selection.

The parameters determining egg morphology are used in the evaluation of elite birds (Parsons and Ridlen, 1985; Pyrzak and Siopes, 1986).

The weight and the proportions of egg components white, yolk and shell, vary considerably among the various lines and breeds (Pandey et al., 1986).

With increasing the egg weight, egg shell thickness, the percentage of the total and thick albumen, the ratio of the total, thick and thin albumen to the yolk was elevated, whereas the proportions of the egg shell vs the whole egg, the percentage of the yolk and the yolk index are reduced (Bachev et al., 1970).

Sharalanov (1973) established a moderate positive correlation between egg shell thickness and egg weight in three lines of hens, but not between the shape index and egg weight. According to Mohanty et al. (1986) and Shishkin (1989) there was a tendency towards reduced egg shell thickness with increasing egg weight.

The albumen weight was found to depend more closely on egg weight than the yolk and eggshell did (Scott et al., 2000). According to the studies of Suk and Park (2001) the weights of albumen, yolk and shell were positively associated to egg weights in ISA Brown and native Korean hens. The presented bibliographic data reveal that the relationships between the morphological traits of eggs are not consistent.

The aim of the present study was to establish the phenotypic correlations between the morphological traits of eggs from turkey lines reared at the Hybrid Centre of Poultry Breeding, Stara Zagora as a part of a study on their production traits with regard to the proper decision-making in selection.

Material and Methods

The study was performed in 2004 in the selection farm of the Hybrid Centre of Poultry Breeding at the Agricultural Institute, Stara Zagora. Eggs from turkeys from the following lines were investigated: Super Heavy (SH), Meat Heavy (MH), Layer heavy (LH), Layer Light (LL), North Caucasian Bronze (NCB) as well as the parental UK line BIG-6, imported in 2003.

The birds were fed and reared under uniform conditions according to the technological requirements. At the age of 30-32 weeks, 30 eggs produced by each line were taken for examination of the following morphological traits: egg weight, egg yolk weight and egg shell weight with a precision of 0.01 g. The shape index was determined according to the formula ShI (%) = d/D x100; the yolk index YI (%) = (h/d) x100 and the albumen index AI (%) = (h/[D+d]/2) x100.

The correlation coefficients and their statistical significance were determined for the relationships among the following traits: egg weight to yolk and shell weights, egg weight to shape, albumen and yolk indices; shell weight to yolk weight, shape, albumen and yolk indices; shape index to yolk weight, yolk index to albumen index; albumen index to yolk weight and yolk index; yolk weight to yolk index.

The correlation coefficients were determined by means of the Pearson Correlation Analysis (MS Excel 2000).
Results and Discussion

The data of the study on correlations among the morphological traits of eggs obtained from hens at the age of 32 weeks are presented in Tables 1, 2, 3, 4, 5 and 6.

Egg weights in all six experimental groups correlated positively to shell weights. The correlation coefficient was high in LL (r=0.84; Table 1), MH (r=0.83; Table 2) and significant in LL (r=0.68; Table 4) (P<0.001). The correlation coefficient was positive and moderate in the SH group (r=0.48; P<0.01) and the NBC group (r=0.23; P>0.05) (Tables 3 and 5, respectively).

The egg weight and the yolk weight correlated positively. This was particularly apparent in eggs of hens from the LL, MH, SH lines where the correlation coefficients were r=0.83, r=0.78 and r=0.68, respectively (P<0.001). An exception were the BIG-6 eggs, where this association was found to be insignificant r=0.29 (P>0.05).

The shape index correlated negatively and poorly to egg weight in the NBC line (r= 0.12; Table 5), and the correlation coefficient was statistically insignificant (P>0.05). The tendency towards negative correlation was observed in all studied turkey eggs, but at a different extent. The results of the study showed that turkey eggs with higher weight were with a shorter shape. It is known that shape index does not depend on egg weight. The correlations obtained in turkeys (Tables 2 and 3) were low and insignificant.

Table 1
Correlation of morphological traits of eggs from turkey Layer heavy (LH) at 32 wk of age

<table>
<thead>
<tr>
<th></th>
<th>Egg weight, g (r ± Sr)</th>
<th>Shell weight, g (r ± Sr)</th>
<th>Shape index (r ± Sr)</th>
<th>White index (r ± Sr)</th>
<th>Yolk index (r ± Sr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell weight, g</td>
<td>0.84±0.10***</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape index</td>
<td>-0.38±0.17*</td>
<td>-0.13±0.19</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White index</td>
<td>-0.21±0.19</td>
<td>-0.17±0.19</td>
<td>0.24±0.18</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Yolk index</td>
<td>0.21±0.19</td>
<td>0.19±0.19</td>
<td>-0.17±0.19</td>
<td>0.63±0.15***</td>
<td>1</td>
</tr>
<tr>
<td>Yolk weight, g</td>
<td>0.47±0.17*</td>
<td>0.47±0.17*</td>
<td>-0.08±0.19</td>
<td>0.03±0.19</td>
<td>0.002±0.19</td>
</tr>
</tbody>
</table>

* Significant differences at   P<0.05; ** P< 0.01; ***= P<0.001

Table 2
Correlation of morphological traits of eggs from turkey Meat Heavy (MH) at 32 wk of age

<table>
<thead>
<tr>
<th></th>
<th>Egg weight, g (r ± Sr)</th>
<th>Shell weight, g (r ± Sr)</th>
<th>Shape index (r ± Sr)</th>
<th>White index (r ± Sr)</th>
<th>Yolk index (r ± Sr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell weight, g</td>
<td>0.83±0.11***</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape index</td>
<td>-0.39±0.17</td>
<td>-0.43±0.17*</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White index</td>
<td>-0.30±0.18</td>
<td>-0.17±0.19</td>
<td>0.17±0.19</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Yolk index</td>
<td>-0.19±0.19</td>
<td>0.05±0.19</td>
<td>0.22±0.18</td>
<td>0.44±0.17*</td>
<td>1</td>
</tr>
<tr>
<td>Yolk weight, g</td>
<td>0.78±0.12***</td>
<td>0.70±0.13***</td>
<td>-0.07±0.19</td>
<td>-0.07±0.19</td>
<td>0.19±0.19</td>
</tr>
</tbody>
</table>

*Significant differences at   P<0.05; ** P< 0.01; ***= P<0.001
The results of the study did not exhibit statistically significant relationships among egg weight and albumen and yolk indices. The correlation coefficient values were negative and close to zero (Table 4) whereas in the other lines (Tables 1, 2, 3, 5 and 6) - negative and low. In all six groups, there was not a trend towards yolk
Phenotypic Correlation between Some Morphological Characteristics of Eggs...

The quality of the shell is important for breeding and commodity eggs. It is related with the strength of the shell which correlated with her thickness (Choi et al., 1983; Stadelman, 1986).

The data about the relationships between shell weight and some principal morphological traits of eggs evidenced a statistically significant negative and moderate correlation. In MH eggs, the correlation coefficient of shell weight and shape index (Tables 2 and 5) was \( r = 0.43 \) (P<0.05) and in NCB eggs: positive and moderate (\( r = 0.46; \) P<0.05). On this basis, it could be assumed that the shape index could be informative about shell weight and consequently, about its quality. The results of the other groups revealed low and moderate negative correlations (Tables 1, 3, 4 and 6).

The phenotypic correlations between the shell weight and the yolk index were weak and positive in LH eggs (Table 1; \( r = 0.19 \)), LL eggs (Table 4; \( r = 0.09 \)) and NCB eggs (Table 5 \( r = 0.09 \)), SH eggs (\( r = 0.27 \); Table 3) and MH eggs (\( r = 0.05 \); Table 2). In BIG-6 eggs the correlation was significant and negative: \( r = 0.51 \) (P<0.01).

With respect to shell weight and yolk weight, in MH and LL eggs the relationship was strong and statistically significant (\( r = 0.70 \) and \( r = 0.66 \), respectively; \( P < 0.001 \)) (Tables 2 and 4). In the other lines, the data were not consistent and the observed relationships varied from positive and moderate in the LH line (\( r = 0.47 \); Table 1) (P<0.05) to negative and negligible in the BIG-6 line (\( r = 0.05 \); Table 6) (P>0.05).

The shape index correlated weakly and negatively to albumen index in SH eggs (\( r = 0.02 \); Table 3) and negatively and moderately to NCB eggs (\( r = 0.51 \), Table 5) (P>0.05). In the LL group, the correlation was higher and positive \( r = 0.60 \) (P<0.001). The eggs with higher shape index had also higher albumen and yolk indices.

The egg weight did not increase parallelly to egg shape index.

The correlation between albumen and yolk indices was strong, positive and statistically significant \( r = 0.63 \), (Table 1) (P<0.001) and \( r = 0.53 \), Table 4 (P<0.01). The relationships presented in Tables 2, 3, 5, and 6 were moderate, positive, but in some cases, not statistically significant. This allows a simultaneous selection for improving the quality of both yolk and albumen.

The calculated correlation coefficients did not evidence any relationship between

### Table 6

**Correlation of morphological traits of eggs from turkey BIG-6 at 32 wk of age**

<table>
<thead>
<tr>
<th></th>
<th>Egg weight, g ( r \pm Sr )</th>
<th>Shell weight, g ( r \pm Sr )</th>
<th>Shape index ( r \pm Sr )</th>
<th>White index ( r \pm Sr )</th>
<th>Yolk index ( r \pm Sr )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell weight, g</td>
<td>0.49±0.16**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape index</td>
<td>-0.57±0.16**</td>
<td>-0.26±0.18</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White index</td>
<td>-0.21±0.18</td>
<td>-0.25±0.18</td>
<td>0.32±0.18</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Yolk index</td>
<td>0.11±0.19</td>
<td>-0.51±0.16**</td>
<td>0.02±0.19</td>
<td>0.30±0.18</td>
<td>1</td>
</tr>
<tr>
<td>Yolk weight, g</td>
<td>0.29±0.18</td>
<td>-0.05±0.19</td>
<td>-0.36±0.18</td>
<td>-0.35±0.18</td>
<td>-0.06±0.10</td>
</tr>
</tbody>
</table>

*Significant differences at \( P < 0.05 \); ** \( P < 0.01 \); *** \( P < 0.001 \)
Given that the yolk index correlated weakly and positively or negatively to egg weight, it could be anticipated that it would not correlate with yolk weight as well. In fact, the correlation coefficients were close to zero in the eggs of the LH, LL and BIG-6 lines $r=0.002$, $r=0.06$ and $r=0.06$, respectively (Tables 1, 4 and 6). In NBC eggs, yolk index correlated weakly and negatively to yolk weight with $r=0.21$ (Table 5). In the SH line, the observed relationship was negative and moderate: $r=0.46$ at $P<0.05$ (Table 3).

**Conclusion**

The observed correlations between the egg weight and yolk weight in hens from the LL, MH and SH lines were positive and statistically significant ($r=0.83$, $r=0.78$ and $r=0.68$, respectively). The egg weight exhibited the same relationship to shell weight in LH ($r=0.84$), MH ($r=0.83$) and the LL ($r=0.68$) lines ($P<0.001$).

The augmentation of the shape index, the albumen index and yolk index did not result in increased egg weight. The observed correlation coefficients were negative and negligible ($P<0.05$).

The increased yolk weight would result in higher shell weight in hens from the MH ($r=0.70$), the LL ($r=0.66$) ($P<0.001$) and the LH ($r=0.47$) lines ($P<0.01$).

There was not a correlation between yolk weight and the yolk index in turkeys at the age of 32 weeks that suggested the performance of independent selection for these traits.

**References**


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