

## EXTERIOR CHARACTERISTICS OF SOME BULGARIAN CHICKEN BREEDS

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### Abstract

The aim of the study was to compare some of the main morphological and morphometric features of four breeds originating from the region of Southwest Bulgaria - Struma chicken (SCh), Rhodope painted chicken (RPCh), Southwest Bulgarian chicken (SWBCh), and Bulgarian longcrower (BL). Almost all studied breeds showed the presence of characteristic plumage mutations - beard, crest, and feathered shanks, with the exception of the Rhodope painted chicken. Struma chicken breed had the highest live body weight, with average values of  $3309.3 \pm 351.8$  g and  $2567.3 \pm 372.9$  g for roosters and hens, respectively ( $P < 0.001$ ). The weight of Southwest Bulgarian chicken breed is the lowest,  $2419.6 \pm 419.6$  g and  $1998.0 \pm 222.6$  g respectively ( $P < 0.001$ ). The Struma chicken breed has the highest values in terms of the Massiveness Index,  $13.79 \pm 1.08$  for roosters and  $12.24 \pm 1.39$  for hens respectively ( $P < 0.001$ ). The representatives of the Struma chicken showed the highest values of Compactness Index ( $181.6 \pm 15.3$  for roosters and  $180.2 \pm 14.52$  for hens, respectively), and the lowest - for roosters ( $158.2 \pm 13.82$ ) and hens ( $157.4 \pm 10.82$ ) from the Southwest Bulgarian chicken. Regarding the Long-leggedness Index, the mean values between roosters and hens of the four studied breeds were close, ranging from 42.01 (BL) to 46.55 (SCh) for roosters and between 37.65 (RPCh) and 44.67 (SCh) for hens. Despite their close ancestry, long-term multivariate selection applied to each of the four breeds has shown significant exterior differences, both in terms of exterior dimensions and phenotypic characteristics.

**Keywords:** breed, Bulgaria, phenotype, chicken.

### Introduction

The observed total globalization in poultry breeding is associated with a strong limitation of the number of companies engaged in breeding (Gura, 2007) and with a concentration of genetic resources, which leads to a serious reduction of genetic diversity in industrial poultry sector (Besbes et al., 2007). Highly productive stock hybrids are gradually displacing native breeds and breed groups, further limiting genetic variation in the domestic chicken (Lukanov, 2016). Despite the proven reduction in genetic diversity, high heterozygosity is still observed in domestic chicken populations from Africa, South America, and some Asian and European breeds (Malomane et al., 2019).

Today, more than 1000 breeds and breed groups of domestic chickens are known (DAD-IS, 2023), and only a few of them have been implemented in industrial poultry farming (Teneva et al., 2015). Europe is one of the main centers where a huge number of chicken breeds were created (Lukanov, 2017). Scientific research of local breeds in Bulgaria started in the 20s of the last century (Tabakov and Chlebarov, 1930). The Bulgarian local breed groups of chickens were studied, and a later a selection work began for creation of two Bulgarian dual-purpose chicken breeds (Pavlova et al., 2021). Of all of them, to this day, only the Black Shumen chicken and the Stara Zagora red chicken have been preserved (Lukanov, 2017a). The breeds of chickens raised by amateur poultry breeders remain out of sight of scientists and state institutions. Besides the two Bulgarian breeds mentioned above, there are several other breeds that were created in Bulgaria by amateur poultry breeders. These are the Katunitsa chicken, the Struma chicken, the Southwest Bulgarian chicken, the Bulgarian longcrown, the Rhodope painted chicken, the Bregovska dzhinka, the Struma bantam and the Southwest Bulgarian dzhinka (Lukanov, 2011a, b; Teneva et al., 2015; Lukanov and Pavlova, 2021). The subject of scientifically based research, of all the above-mentioned modern Bulgarian breeds of chickens, were the Black Shumen chicken, the Stara Zagora red chicken, the Katunitsa chicken and the Southwest Bulgarian dzhinka. This scarcity in terms of information on the distribution, exterior and productivity of the Bulgarian chicken breeds gave rise to the purpose of the present article. The aim of the study was to compare some of the main morphological and morphometric features of four breeds originating from the region of Southwest Bulgaria - Struma chicken (SCh), Rhodope painted chicken (RPCh), Southwest Bulgarian chicken (SWBCh), and Bulgarian longcrown (BL).

## Material and methods

The study was conducted during the period from 11.12.2021 to 08.10.2022 in the region of Southwest Bulgaria, where are the most typical representatives of the Struma chicken (Pernik region, Bulgaria), Rhodope painted chicken (Momchilgrad region, Bulgaria), Southwest Bulgarian chicken (Banya village, Blagoevgrad Province, Bulgaria), and Bulgarian longcrown (Kurdzhali region, Bulgaria) breeds. A total of 60 roosters and 100 hens of those breeds were subjected to morphological and morphometric analysis (15 roosters and 25 hens from each breed). The average age of the tested roosters was 14 months with minimal/maximal variations of 7 to 36 months. The average age of the tested hens was 19 months, encompassing birds from 7 to 48 months old.

The following morphological characteristics were monitored:

- Phenotypic assessment of eye, shanks, and plumage color, comb type, beard/muffs, crest development, and foot-feathering development.
- Live body weight (g).
- Body dimensions. They were measured in the following order: body length (cm); breast width (cm); breast depth (cm); body circumference (cm); breast length (cm); lower leg length (cm); wing length (cm); wingspan (cm); shank length (cm); shank circumference (cm); comb length (mm); comb height (mm); beak length (mm); beak width (mm); wattles length\* (mm); wattles width\* (mm). \*only in nonbearded breed - Rhodope painted chicken.

Based on the conducted morphometric analysis, the following body conformation indices were calculated:

- Massiveness index (MI) = (live weight/body length)\*100
- Compactness index (CI) = (breast circumference/body length)\*100
- Long-leggedness index (LI) = (leg length/body length)\*100

The statistical analysis was performed via statistical software IBM® SPSS® Statistics (V26). Due to the study's specifics, data for mean (m), standard deviation (SD) and coefficient of variation (CV, %) values were included as well. The male/female and between-breed differences were considered statistically significant at  $p < 0.05$ , using Student's t-test, if the data were normally distributed.

## Results and discussion

Table 1 presents the summary data concerning the main phenotypic characteristics of the four studied breeds. An impression is made by the presence of different comb types. The Struma chicken and the Rhodope painted chicken are mainly characterized of the single comb type (*rrpp* genotype). In SCh, a pea-shaped comb is also allowed by standard, and single individuals with a rose-shaped comb are also observed (Lukanov, 2017a). For the purposes of the study, only birds with typical external markings were used, and for this breed - only with a single-shaped comb. In contrast to the SCh, no other type of comb is allowed in the RPCh, except single-shaped (Pavlova et al., 2021). A pea-shaped comb type (*rrPP/rrP\_*) characterizes the breed BL, although there are single birds with a strawberry-shaped type (*RRPP; R\_P\_*), characteristic of the SWBCh. In the latter, especially in the female individuals, there are also birds with a pea-shaped comb. While only one type of comb is allowed in the breeds that have been worked according to the breed standard, with some exceptions such as Leghorn, Rhode Island Red, Orpington (Lukanov, 2017a), then in the more primitive breeds there is frequent variation in some external signs, incl. comb shape (DAD-IS, 2023). As expected, the comb of the single-type breeds - SCh and RPCh ( $P < 0.001$ ) stand out with the largest sizes ( $P < 0.001$ ). In RPCh the comb is longer ( $P < 0.001$ ) and almost similar in height in the representatives of SCh, observed in both sexes. In the remaining two breeds with pea- and strawberry-type comb, close values are observed, with regard to its length BL show significantly higher values ( $P < 0.05$ ), while in terms of width - the dependence is reversed - in favor of SWBCh ( $P < 0.001$ ). These results are directly related to the characteristics of those two comb types.

Regarding the color of the eyes, all the presented breeds are characterized by an orange-red color of the iris, which is also typical for a large part of known breeds around the world (Lukanov, 2017a). The same can be said to some extent about the color of the legs (shanks), with all four breeds having a base color of yellow with slight variations to a lighter or darker yellow (BL). A relatively large proportion of birds with white legs are found in BL. From the leg measurements taken, no statistically significant differences were found between the roosters from the four breeds, both in terms of length and circumference ( $P > 0.05$ ). On the other hand, the differences between hens of most breeds were statistically proven, where the greatest length ( $9.35 \pm 0.96$  cm) and circumference ( $5.05 \pm 0.48$  mm) of the leg was distinguished by SCh ( $P < 0.01$ ). The average length of the lower leg was highest in BL roosters ( $17.14 \pm 0.7$  cm) and SWBCh hens ( $14.32 \pm 1.25$  cm), and the lowest average sizes were distinguished by roosters and hens from the RPCH group ( $15.38 \pm 1.25$  cm and  $12.64 \pm 1.0$  cm, respectively).

Table 1. Main phenotypic characteristics of the studied chicken breeds

| Parameter           | SWBCh            | SCh              | RPCh       | BL           |
|---------------------|------------------|------------------|------------|--------------|
| Comb type           | Strawberry       | single/pea       | single     | pea          |
| Eye color           | orange-red       | orange-red       | orange-red | orange-red   |
| Shank color         | yellow           | yellow           | yellow     | yellow/white |
| Beard               | yes              | yes              | no         | yes          |
| Crest               | no               | yes              | no         | no           |
| Feathered legs      | yes              | yes              | no         | yes          |
| Main plumage colors | red spangled     | chamois spangled | mottled    | black yellow |
|                     | light spangled   | red spangled     |            |              |
|                     | chamois spangled | mottled          |            |              |

Concerning the mutations of the plumage, it can be said that the SCh unites all presented here - beard, crest and feathered legs, while the RPCh lacks them. Mutation plumage formations were extremely well developed in the Struma chicken, reflecting in an extremely attractive appearance. Other Balkan breeds with similar plumage features are Struma bantam (Teneva et al., 2015) and Sultan chicken (Lukanov, 2012). Although the typical representatives of the Rhodope painted chicken do not have such mutations, there are specimens with a beard or light leg feathering. The SWBCh has a well-developed leg-feathering and beard, while the BL is distinguished by a relatively well-developed beard and moderate to light feathered shanks. Comparing BL with the other known longcrowing breeds (Lukanov, 2017b), it can be concluded that they have exterior characteristics that are absent in any of the others - the presence of a beard, feathered shanks, and a pea-shaped comb.

With the most variations in plumage color, the SCh undoubtedly stands out, but the most common are in the range of spangled and mottled colors. The other ones with a few main plumage variations is SWBCh – mainly in spangled (red, light, and chamois), but could be found in white, blue, and black. The other two are distinguished with black-white mottled (RPCh) and black-yellow (BL) plumage color. In RPCh there are some specimens with red spangled plumage color. In BL plumage color is typical as could be seen in Denizli longcrowing chicken breed (Schwarz and Six, 2004).

Figure 1 presents the results obtained in terms of average live body weight measured in both sexes of the studied breeds. It is clearly seen that the SCh group is distinguished by the highest parameter values, respectively  $3309.3 \pm 351.8$  g for roosters and  $2567.3 \pm 372.9$  g for hens ( $P < 0.001$ ). The lowest live body weight was recorded in the group of SWBCh, respectively  $2419.6 \pm 419.6$  g in roosters and  $1998.0 \pm 222.6$  g in hens ( $P < 0.001$ ). This SCh/SWBCh difference is 26.9% for roosters

and 22.2% for hens. The greatest variation in the parameter was observed in the males of the SWBCh group (CV = 17.3%), and for the females - in the SCh group (CV = 14.5%). For the rest, the coefficient of variation was between 8.06% (RPCh roosters) and 12.87% (BL hens). The

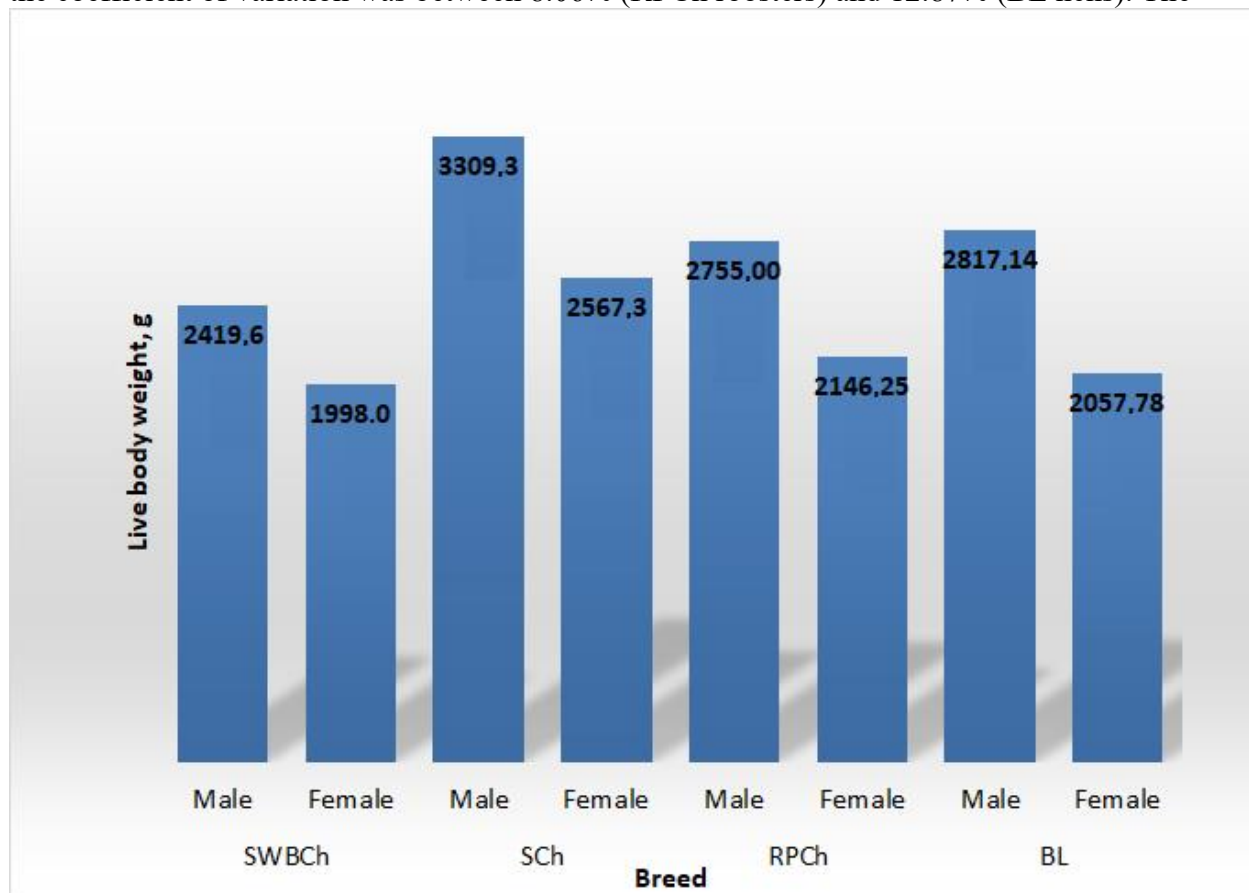


Figure 1. Live body weight according to breed and gender (g)

representatives of the RPCh and BL breeds had close values in terms of mass in male and female individuals, with a between groups gender difference of 2.2% and 4.1%, respectively. Analyzing these systematized data, we can place the considered four breeds in the groups of medium-weight and light chicken breeds. In the class of medium-weight breeds, only SCh can be included, where the weight range for roosters is usually between 3.0 and 4.0 kg, and for hens 2.5-3.0 kg (Genchev and Lukanov, 2018). The SWBCh in its weight mean values is a typical representative of the light breeds of chickens, which are usually in the range of 2.0-2.5 kg for roosters and 1.4-2.0 kg for hens (Genchev and Lukanov, 2018). The remaining two breeds (RPCh and BL) showed intermediate weight-class position, with roosters closer to medium-heavy breeds and hens to light ones. In appearance, they are closer to light breeds, having a more elegant body and a less well-developed breast area. Due to the presence of specific exterior characteristics, and in the case of BL and behavioral ones, the SCh, SWBCh, and BL breeds can also be included in the decorative class of chicken breeds, which was most likely the driving force for their creation (Lukanov, 2017). The BL in its live body weight approaches the most longcrowing Balkan breeds, with the exception of

the Sanjak longcrouer, which has a higher live weight (Lukanov, 2017b), including his probably closest relative – Denizli breed (Schwarz and Six, 2004; EE, 2012). Perhaps the closest breed to the SWBCh is the Orloff, which, however, has a significantly higher live body weight, different in its type, and lack of shanks feathering (EE, 2012; Lukanov, 2017a). The closest breed to the RPCh

Table 2. Some body dimensions, divided by gender and breed group.

| Parameter               | Breed  | SWBCh        |              | SCh           |                | RPCCh         |               | BL            |               |
|-------------------------|--------|--------------|--------------|---------------|----------------|---------------|---------------|---------------|---------------|
|                         | Gender | ♂            | ♀            | ♂             | ♀              | ♂             | ♀             | ♂             | ♀             |
| Body length, cm         | x±SD   | 21.68±1.19a* | 18.96±1.46a* | 24.0±1.73a*   | 20.93±1.23a*   | 23.19±0.37ab* | 20.77±1.04a*  | 25.43±1.1ab*  | 21.15±1.11a*  |
| Breast weight, cm       | x±SD   | 8.91±0.75a*  | 7.9±0.43a*   | 10.29±0.47a*  | 8.83±1.04b*    | 10.44±0.62a*  | 7.89±0.6b*    | 10.36±0.56a*  | 8.36±0.59a*   |
| Breast depth, cm        | x±SD   | 13.28±1.01a* | 12.31±0.72a* | 14.5±1.04     | 13.59±1.21a    | 14.56±1.55*   | 13.22±0.88a*  | 14.57±0.6a*   | 12.97±0.97*   |
| Body circumference, cm  | x±SD   | 38.81±3.8a*  | 34.24±2.05a* | 43.53±4.15    | 37.65±3.31ab*  | 41.36±5.1*    | 36.75±3.31*   | 42.24±1.35a*  | 35.47±1.92b*  |
| Breast length, cm       | x±SD   | 12.7±1.33a*  | 11.4±0.84a*  | 14.61±0.83ab* | 12.65±1.17ab*  | 14.13±1.51ac* | 12.14±1.36*   | 15.99±0.51bc* | 11.92±0.59ab* |
| Lower leg length, cm    | x±SD   | 16.29±1.59*  | 14.32±1.25a* | 15.93±1.17a*  | 14.03±0.99b*   | 15.38±1.25b*  | 12.64±1.0ab*  | 17.14±0.7ab*  | 13.08±0.89ab* |
| Shank length, cm        | x±SD   | 10.93±0.87*  | 9.26±0.69a*  | 11.14±0.69*   | 9.35±0.96b*    | 10.0±1.07*    | 7.81±0.6ab*   | 10.64±0.9*    | 8.19±0.59ab*  |
| Shank circumference, cm | x±SD   | 8.87±0.4*    | 4.6±0.37a*   | 6.07±0.73*    | 5.05±0.48ab*   | 5.45±0.42*    | 4.2±0.38abc*  | 5.86±0.36*    | 4.62±0.41bc*  |
| Wing length, cm         | x±SD   | 37.67±1.48a* | 32.74±1.29a* | 37.79±3.08b*  | 34.33±2.16abc* | 35.13±2.03ac* | 31.83±1.62b*  | 42.1±1.26abc* | 32.2±2.22c*   |
| Wingspan, cm            | x±SD   | 82.71±3.5a*  | 73.32±2.37a* | 87.57±4.86b*  | 77.88±4.31ab*  | 80.63±1.77bc* | 72.12±2.74bc* | 91.11±2.24ac* | 75.02±3.69c*  |

**Note:** values marked with the same letters are related to statistically significant intergroup differences at P<0.05; Values marked with an asterisk are associated with statistically significant gender differences at P<0.05.

in terms of external features is the Asturian Painted chicken, originating from Spain, it has a significantly higher live weight (Rodríguez et al., 2009) and a different exterior type.

In Table 2, the summary values of the remaining exterior measurements taken in the four breeds can be seen. It can be summarized that they don't strictly follow the dependence related to the live body weight, which could be expected that reflects on their body size, and from there on the exterior dimensions.

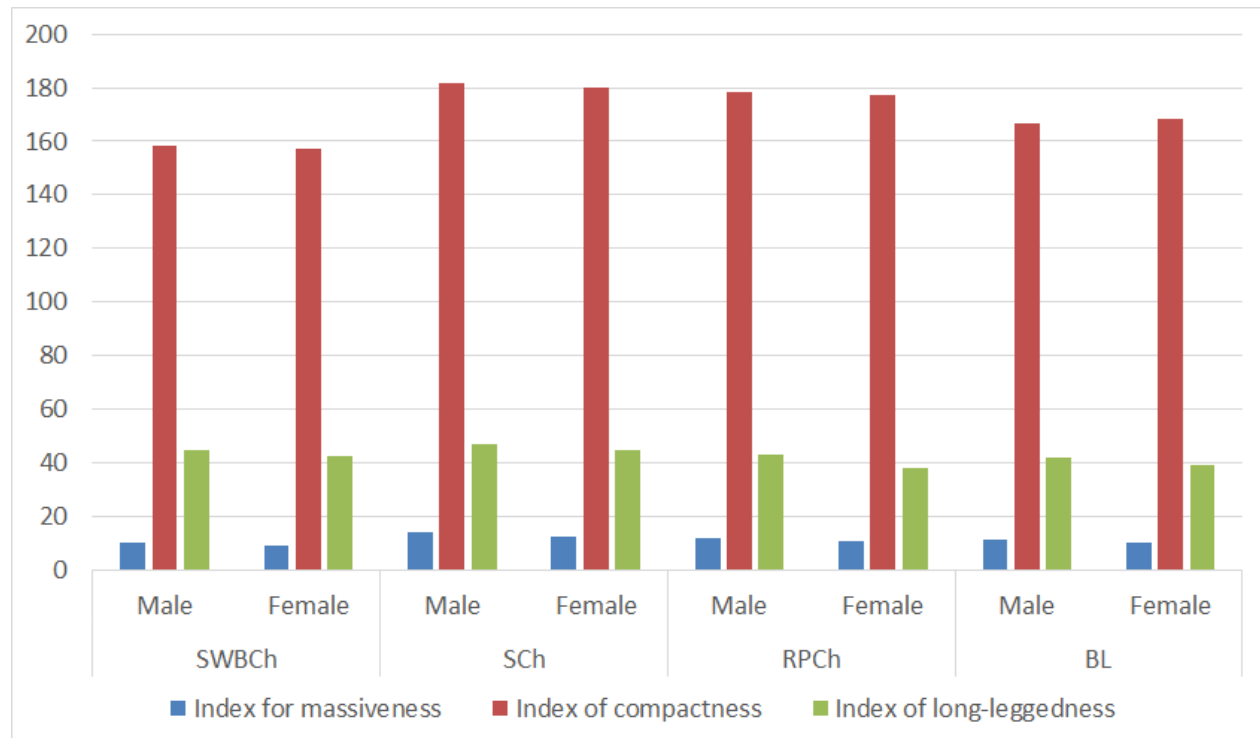


Figure 2. Body conformation indices reported in the investigated chicken breeds

Exterior indices represent a summary characteristic of some of the main body dimensions. In figure 2 can be seen the main exterior indices used in poultry farming, calculated for the four studied breeds. The SCh had the highest values in terms of the Massiveness Index,  $13.79 \pm 1.08$  for roosters and  $12.24 \pm 1.39$  for hens respectively ( $P < 0.001$ ). The representatives of the SCh also showed the highest values in terms of Compactness Index ( $181.6 \pm 15.3$  for roosters and  $180.2 \pm 14.52$  for hens, respectively). The lowest CI was determined for roosters ( $158.2 \pm 13.82$ ) and hens ( $157.4 \pm 10.82$ ) from the SWBCh group. Regarding the Long-leggedness Index, the mean values between roosters and hens of the four studied breeds were close, ranging from 42.01 (BL) to 46.55 (SCh) for roosters and between 37.65 (RPCh) and 44.67 (SCh) for hens. Male birds showed a tendency towards higher values in relation to the three indices, the differences being most pronounced in LI, which is closely related to gender differences. Comparing the values obtained by us for the three indices for body conformation with those presented in several broiler hybrids (Kokoszyński et al., 2017), it can be summarized that despite the differences in breeding and age, the values regarding MI are comparable. As for the CI, only at SWBCh comparable values are observed with those presented

in broiler chickens (142.0-158.0 at broilers vs 157.4-158.2 at SWBCh). The other three genotypes, showed higher CI mean values than those presented for broilers. The LI reported by us in all four groups (37.7-46.6) was significantly higher than that of broiler chickens (33.9-34.9). Comparing our results with those presented by a local breed, a typical representative of light breeds of chickens – Shumen chicken (Lukanov et al., 2018), it can be said that with regard to MI the results presented here are higher, as for roosters as well as hens (vs 9.15 in Shumen roosters and 7.86 in Shumen hens). The reported CI in the cited study was comparable for male and female individuals of the SWBCh and BL group but was lower compared to that of SCh and RPCh. Both roosters and hens of the breed (Shumen chicken) are distinguished by lower mean values in terms of LI compared to the breeds presented here (vs 41.05 for roosters and 34.9 for hens).

## Conclusions

The presented Bulgarian breeds show distinctive exterior characteristics that distinguish them from other known breeds of chickens. All described breeds have a basic spangled color of the plumage, except Bulgarian longcrower. Only the Struma chicken combines all the described plumage mutations - beard, crest, and feathered legs, while the Rhodope painted chicken lacks them. The summary data in terms of live weight gives us reason to assume that the Struma chicken is in the weight range characteristic of the medium-weight type of chickens, while the other three breeds show characteristics of the light type of chickens. With the most massive and compact body, the Struma chicken stand out, while the Southwest Bulgarian chicken have the lowest MI and CI values. All four breeds show close values regarding the ratio of leg length to body length (LI).

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