NATIONAL AGRICULTURAL AND FOOD CENTRE
RESEARCH INSTITUTE FOR ANIMAL PRODUCTION NITRA

Slovak J. Anim. Sci., 50, 2017 (3): 112–117

ISSN 1337-9984

FACTORS AFFECTING GROWTH IN NATIVE ORAVKA CHICKEN BREED

E. HANUSOVÁ[1]*, M. ORAVCOVÁ[1], A. HANUS[1], C. HRNČÁR[2]

[1]NPPC – Research Institute for Animal Production Nitra, Lužianky, Slovak Republic
[2]Slovak University of Agriculture in Nitra, Slovak Republic

ABSTRACT

The objective of this study was to analyse the effect of the most important factors affecting growth (body weights of 5-, 12- and 20-week old males and females) in Oravka chickens. In total, 359 individuals of conservation flock (operated by the National Agriculture and Food Centre – Research Institute of Animal Production Nitra) were studied. The mixed model included fixed effects of sex, age, rooster/breeding season, an interaction of sex and age nested within rooster/breeding season and random effect of bird due to repeated weights of each individual. All fixed effects highly significantly ($P < 0.01$) influenced body weight of birds; repeatability attributable to among-individual variation was estimated to be about 35 % proportion of variance. With respect to rooster/breeding season, body weights in 5-week old birds (between 384.62 ± 32.11 g and 572.04 ± 23.39 g for males vs. between 343.33 ± 35.73 g and 497.71 ± 26.10 g for females) were non-significant ($P > 0.05$); body weights in 12-week old birds (between 1299.51 ± 26.85 g and 1464.29 ± 23.39 g for males vs. between 1071.90 ± 25.27 g and 1134.83 ± 25.57 g for females) were either non-significant ($P > 0.05$) or significant ($P < 0.05$); body weights in 20-week old birds (between 2237.24 ± 31.17 g and 2633.76 ± 47.84 g for males vs. between 1615.77 ± 34.80 g and 2056.84 ± 37.56 g for females) were at least significant ($P < 0.05$).

Key words: genetic resources; chicken; body weight; growth factors

INTRODUCTION

Poultry breeding has undergone enormous changes during the last decades. The antagonistic relationship between meat and laying performance led the poultry industry to the separation of two lines of production: meat production and egg production (Siegman and Neumann, 2005).

Body weight, a high heritability trait, is an important economic factor mainly for broiler chickens reflecting the production level and economic benefits of a farm. The growth rate is related primarily to genetic factors, expression of which depends on the environmental factors (Gerken *et al*., 2003). A common practice in poultry production is to measure the increase in body mass of birds to control and modify the external conditions that affect their weight gain (Oliveira *et al.*, 2000; Agudelo Gómez *et al.*, 2008; Aggrey, 2009).

At present, with the growing demand for poultry products from extensive systems, an opportunity arises to increase the importance of native chicken breeds, which are particularly suitable for free range and organic farming because of their good adaptation to the local conditions. This is confirmed by the experience of many countries, in which native breeds of slow-growing chickens provide good-quality meat, which is in increasing demand (Fanatico *et al*., 2005 a, b; Youssao *et al.*, 2009; Smith *et al.*, 2012; Yin *et al*., 2013; Choo *et al.*, 2014; Walley *et al.*, 2015). Compared to fast-growing broilers, native chicken breeds and their hybrids show lower weight gain and smaller proportion of breast muscle in the carcass compared to fast-growing broilers, but their meat has many quality characteristics valued by modern consumers (Sokolowicz *et al.*, 2016).

Oravka chicken is a dual purpose breed of Slovakia provenience; originated with the intention

***Correspondence:** E-mail: hanusova@vuzv.sk
Emília Hanusová, NPPC – Research Institute for Animal Production Nitra, 951 41 Lužianky, Slovak Republic
Tel.: +421 37 6546 360

Received: May 5, 2017
Accepted: August 21, 2017

of having been well adapted to less favourable environment. Population numbers of this breed, which has the status of the only native chicken in Slovakia, are available from the National/European Farm Animal Biodiversity System (http://efabis-sk.cvzv.sk) providing data on farm animal breeds from all around the world. Development of Oravka chicken started in 1950-ies under the guidance of the Research Institute for Poultry by combinatorial crossing of regional breeds with breeds of Rhode Island Red, New Hampshire and Wyandotte White (Chmelničná, 2004). The goal was to develop a breed suitable for harsh climatic conditions of northern Slovakia, which can be kept in free range. It is adapted for egg and meat production and was recognized as an independent breed in 1990. According to breed standard, it is of hard rectangular frame, body weight of males is between 2.8 and 3.3 kg, body weight of females is between 2.2 and 2.7 kg, egg laying ranges from 180 to 200 pcs per year; eggs are of a brownish shell, their average weight is about 55 g.

Some knowledge on growth ability in Slovak chicken breeds is available from earlier works (Malík and Malíková, 1993; Hrnčár *et al*., 2010). To take into account most recent data, this study is aimed at analysis of growth in Oravka birds in dependence on various effects that are assumed to have an influence on body weight. Also, Oravka's growth ability was compared with growth ability of some native and indigenous breeds kept worldwide.

MATERIAL AND METHODS

The birds of conservation flock are kept at the farm of the National Agriculture and Food Centre and operated by the Research Institute for Animal Production (RIAP) Nitra, considered as the *ex situ* flock, were included into the experiment. Breeding males, assumed to be of no genetic ties with breeding females, were used in mating each season (from 2011 to 2015). Thus, descendants of mating between breeding females produced at the farm of the RIAP Nitra and roosters produced out of it were weighed at age of 5, 12 and 20 weeks using the BAT 1 manual poultry scale (produced by VEIT Electronics, Czech Republic). Birds were kept in closed heating nurseries on deep litter (20 chickens per square meter) until 12 weeks of the age; afterwards, they were housed in unheated poultry house, also on deep litter (12 chickens per square meter). Birds were fed (*ad libitum*) the same feed for light chicken (according to age categories); water was available during the whole experiment. Because older birds had to cope with actual weather conditions (free range available) which might vary among seasons, season was considered as the effect that needs to be accounted for. Roosters as sires of next generation were replaced each season, therefore, variance of roosters was hardly possible to distinguish from variance of breeding seasons, and the overlapping effect of rooster/breeding season was considered. A total, 359 individuals that were weighed at least two times during the experiment (five-year duration from 2011 to 2015) were included in analysis. Over rooster/breeding season, individuals were distributed as follows: 90 (1), 47 (2), 80 (3), 54 (4) and 88 (5), respectively.

Statistical analysis was done using the SAS 9.2 statistical programme (2009); the mixed model methodology using MIXED procedure was applied to study the influence of effects causing variation of body weight in Oravka chicken. The model was as follows:

$$y_{ijkl} = \mu + S_i + A_j + R_k + S_i A_j (R_k) + u_l + e_{ijkl}$$

where:
y_{ijkl} – individual body weights
μ – intercept
S_i – fixed effect of sex class (male, female); $\sum_i S = 0$
A_j – fixed effect of age (5, 12, 20 weeks); $\sum_j A = 0$
R_k – fixed effect of rooster/breeding season (1, 2,... 5); $\sum_k R = 0$
$S_i A_j (R_k)$ – interaction of sex x age nested within rooster/breeding season; $\sum_{ijk} SAR = 0$
u_l – random effect of bird (1, 2,... 359); $u_l \sim N(0, I\sigma_u^2)$
e_{ijkl} – random error; $e_{ijkl} \sim N(0, I\sigma_e^2)$

Fixed effects included in the model were estimated using the Least Squares Means (LSM) method. Statistical significances of fixed effects were tested by Fischer's F-test; statistical significances of individual differences between estimated levels of fixed effects were tested by Scheffe's multiple range tests. Differences were considered significant when $P < 0.05$. Bird and residual error variances were estimated using the Restricted Maximum Likelihood (REML) method. Repeatability of body weight in Oravka chicken, estimated taking into account individual bird variances and residual variance: $r^2 = \frac{\sigma_u^2}{\sigma_u^{2+} \sigma_e^2}$ can be interpreted as the proportion of total variance attributable to among-individual variation.

RESULTS AND DISCUSION

Analysis of variance of fixed effects affecting body weight of chicken is given in Table 1. All fixed effects (sex, age of bird, rooster/breeding season as well as interaction between sex and age nested within rooster/breeding season) included in the model were of highly significant influence ($P < 0.01$). The difference in body weights between males (1433.24 ± 12.24 g) and females (1115.01 ± 10.24 g) was 318.22 ± 15.83 g

in favour to males (Table 2).

According to age, the differences in body weights of Oravka chicken found in this study were following: 829.21 ± 10.31 g (between 5- and 12-week old birds), 901.55 ± 15.89 g (between 12- and 20-week old birds) and 1730.76 ± 15.90 g (between 5- and 20-week old birds) in favour to birds of a higher age. Body weights of 5-, 12- and 20-week old birds were estimated as following: 420.80 ± 9.05 g, 1250.01 ± 9.05 g and 2151.56 ± 15.10 g (Table 2). Body weights of 12- and 20-week old birds were found similar to values reported by Hrnčár *et al.* (2010): 1128.53 ± 118.85 g and 1871.85 ± 146.86 g for Oravka breed in field test. Estimated body weights were higher than values reported by Galeano-Vasco *et al.* (2014) for Colombian Lohmann LSL chicken evaluated at the age of 36 days (301.23 ± 49.51 g), at the age of 85 days (902.33 ± 80.79 g) and at the age of 144 days (1561.72 ± 95.04 g). In addition, Zhao *et al.* (2015) reported both lower and higher body weights for indigenous China chicken breeds: 281.81 ± 69.32 g (Shaobo), 512.69 ± 79.96 g (Youxi) and 519.97 ± 88.63 g (Huaixiang) evaluated at the age of 5 weeks. With four varieties of native Assel chicken in Pakistan, Jatoi *et al.* (2014) reported almost two times lower body weights for 4-week old birds when comparing with 5-week old Oravka birds: 202.05 ± 4.29 g (Lakha), 219.79 ± 5.60 g (Mianwali), 229.60 ± 7.24 g (Mushki), 210.60 ± 5.90 g (Peshawari) indicating that body weights of 5-week old Pakistan chicken were unable to reach the same values as Oravka chicken. Also, body weights of 12-week old chicken were lower: 1062.50 ± 34.10 g, 1074.20 ± 25.42 g, 1088.30 ± 30.22 g, 997.30 ± 23.90 g. Similarly low body weights for 4- and 12-week old birds were reported by Adedeji *et al*. (2015) for purebred and crossbred chicken in Nigeria (kept at university operated poultry flock). Ekka *et al.* (2016), who analyzed body weights of native Hansli, Coloured synthetic male line chicken and their crosses from week 1 to week 8 under intensive rearing

Table 1: Analysis of variance of fixed effects on body weight

Source of variance	Body weight (g)		
	DF[2]	Mean Squares	*P*
Sex (S)	1	404.1	< 0.0001
Age (A)	2	7060.8	< 0.0001
Rooster/Breeding season (R)	4	24.2	< 0.0001
SxA (R)[1]	22	24.0	< 0.0001

[1]Interaction SxA nested within R, [2]Degrees of freedom

Table 2: Least squares means and standard errors ($\mu \pm s_{\mu}$) of body weights by sex, age and rooster/breeding season

Effect	Individual levels of investigated single effects				
Sex	Females (F)	Males (M)			
N	479	406			
Body weight (g)	1115.01 ± 10.04	1432.24 ± 12.24			
Scheffe's test	F:M^{++}				
Age	5 weeks	12 weeks	20 weeks		
N	357	356	172		
Body weight (g)	420.08 ± 9.05	1250.01 ± 9.05	2151.56 ± 15.10		
Scheffe's test	5:12^{++}, 20^{++}, 12:20^{++}				
Rooster/breeding s.	1	2	3	4	5
N	205	113	204	132	231
Body weight (g)	1393.24 ± 15.50	1239.23 ± 20.99	1188.87 ± 14.66	1286.87 ± 21.72	1262.42 ± 14.10
Scheffe's test	1:2^{++}, 3^{++}, 4^{++}, 5^{++}, 3:4^{++}, 5^{+}				

N - number of observations, $^{+}P < 0.05$, $^{++}P < 0.01$

system in India, reported body weights of 5-week old birds as follows: 970.02 ± 32.87 g, 317.77 ± 11.09 g and 589.30 ± 23.38 g. McCrea *et al.* (2014), who analyzed body weights of Delaware chicken from week 1 to week 15, reported values of about 500 g (5-week old) and 1600 g (12-week old). The body weight of 15-week old Delaware chicken was 2100 ± 40 g, that indicates that Oravka chicken, compared with this breed, were of a slower growth. In contrast, as these authors mentioned, broilers achieved body weight 2100 ± 40 g at the age of six weeks (despite Delaware and broiler chicken were raised under the same conditions).

According to rooster/breeding season (Table 2), body weights of birds in this study were following: 1393.24 ± 15.5 g (1), 1239.23 ± 29.99 g (2), 1188.87 ± 14.66 g (3), 1286.87 ± 21.72 g (4) and 1262.42 ± 14.1 g (5). The differences were highly significant ($P < 0.01$) or significant ($P < 0.05$) between rooster/breeding season (1) and the remaining ones (2, 3, 4, 5) and between (3) and (4, 5). The differences in body weights tended to decrease along with duration of the experiment, indicating an increasing conformity of body weights among birds. This needs, however, to be considered with caution due to limitations in available information.

Findings from analysis of interaction between sex and age nested within rooster/breeding season revealed that the differences were also higher in favour of males (Figure 1). The older birds, the higher differences between males and females were found. With 5-week old birds, body weights within individual rooster/breeding season (1, 2, 3, 4 and 5) were estimated as follows: between 384.62 ± 32.11 and 572.04 ± 23.39 g for males vs. between 343.33 ± 35.73 and 497.71 ± 26.10 g for females. The differences were non-significant. With 12-week old birds, body weights within individual rooster/breeding season were estimated as follows: between 1299.51 ± 26.85 and 1464.29 ± 23.39 g for males vs. between 1071.90 ± 25.26 and 1134.83 ± 25.57 g for females. The differences were either non-significant or significant. With 20-week old birds, body weights within individual rooster/breeding season were estimated as follows: between 2237.24 ± 31.17 and 2633.76 ± 47.84 g for males vs. between 1615.77 ± 34.80 and 2056.84 ± 37.56 g for females. The differences were significant. Similar values of body weights found in Oravka chicken were reported by Aggrey (2002) for unselected Athens-Canadian chicken population evaluated at the age of 36 days (417.41 ± 59.22 g for males vs. 355.13 ± 49.12 g for

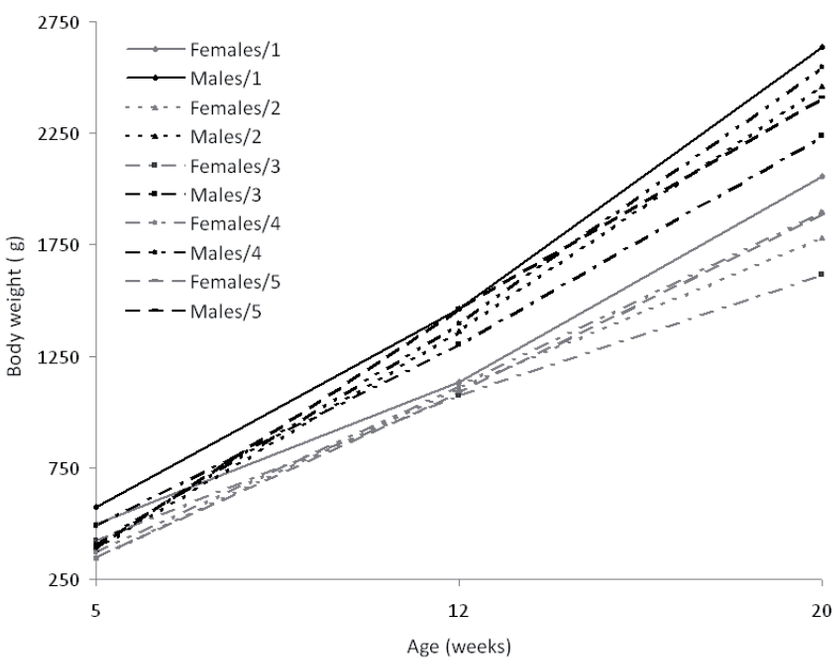

Fig. 1: Body weight according to sex (males, females), age (5-, 12- and 20-week old birds) and nested within rooster/breeding season (1, 2,… , 5)

females), at the age of 85 days (1326.49 ± 176.84 g for males vs. 1009.48 ± 130.78 g for females) and at the age of 141 days (2142.31 ± 243.44 g for males vs. 1619.34 ± 212.78 g for females). Malík and Malíková (1993) reported body weights for 12-and 20-week old birds of Oravka breed as follows: between 1090 g and 1280 g for males vs. between 1000 g and 1100 g for females, and between 1900 g and 2100 g for males vs. 1710 g and 1800 g for females, respectively. This comparison indicates that the ongoing breeders' preference of morphology traits did not influence Oravka chicken's growth in the negative way.

Repeatability treated as a random effect of bird was moderate, accounting for about 35 % of total variance of body weight.

CONCLUSION

Analyses showed significant effects of selected factors (sex, age, rooster and/or breeding season and interaction between sex and age nested within rooster/breeding season) on body weights in Oravka chicken breed. Along with increasing age of birds, body weights of males were higher than body weights of females. Further research taking into account body weights of birds weighed more often during growth phase of their life, and also including evaluation of body weights weighed at a higher age is needed to be done for describing growth curves in detail.

ACKNOWLEDGEMENT

The work was supported by the Ministry of Agriculture and Rural Development of the Slovak Republic.

REFERENCES

ADEDEJI, T. A. – AMUSAN, S. A. – ADEBAMBO, O. A. 2015. Effect of chicken genotype on growth performance of pure and crossbred progenies in the development of a broiler line. *International Journal of Agriculture Innovations and Research*, vol. 4, 2015, p. 134–138.

AGGREY, S. E. 2002. Comparison of three nonlinear and spline regression models for describing chicken growth curves. *Poultry Science*, vol. 81, 2002, p. 1782–1788.

AGGREY, S. E. 2009. Logistic nonlinear mixed effects model for estimating growth parameters. *Poultry Science*, vol. 88, 2009, p. 276–280.

AGUDELO GÓMEZ, D. A. – CERÓN MUÑOZ, M. F. – RESTREPO BETANCUR, L. F. 2008. Modelación de las funciones de crecimiento aplicadas a la producción animal. *Revista Colombiana de Ciencias Pecuarias*, vol. 21, 2008, p. 39–58.

CHMELNIČNÁ, L. 2004. Oravka. In: KADLEČÍK, O. – HALO, M. – CHMELNIČNÁ, L. et al.: Ohrozené plemená zvierat na Slovensku. Nitra: SPU, 2004, p. 37–52. ISBN 80-8069-459-1.

CHOO, Y. K. – KWON, H. J. – OH, S. T. – UM, J. S. – KIM, B. G. – KANG, C. W. – LEE, S. K. – AN, B. K. 2014. Comparison of growth performance, carcass characteristics and meat quality of Korean local chickens and silky fowl. *Asian-Australasian Journal of Animal Sciences*, vol. 27, 2014, p. 398–405.

EKKA, R. – BEHURA, N. C. – SAMAL, L. – NAYAK, G. D. – PATI, P. K. – MISHRA, P. K. 2016. Growth performance and linear body measurements of Hansli, CSML and HanslixCSML cross under intensive system of rearing. *Journal of Livestock Science*, vol. 7, 2016, p. 114–121.

FANATICO, A. C. – PILLAI, P. B. – CAVITT, L. C. – OWENS, C. M. – EMMERT, J. L. 2005a. Evaluation of slower-growing broiler genotypes grown with and without outdoor access: growth performance and carcass yield. *Poultry Science*, vol. 84, 2005a, p. 1321–1327.

FANATICO, A. C. – CAVITT, L. C. – PILLAI, P. B. – EMMERT, J. L. – OWENS, C. M. 2005b. Evaluation of slower-growing broiler genotypes grown with and without outdoor access: meat quality. *Poultry Science*, vol. 84, 2005b, p. 1785–1790.

GALEANO-VASCO, L. F. – CERÓN-MUNOZ, M. F. – NARVÁEZ-SOLARTE, W. 2014. Ability of non-linear mixed models to predict growth in laying hens. *Revista Brasileira de Zootecnia*, vol. 43, 2014, p. 573–578.

GERKEN, M. – JAENECKE, D. – KREUZER, M. 2003 Growth, behaviour and carcass characteristics of egg-type cockerels compared to male broilers. *World's Poultry Science Journal*, vol. 59, 2003, p. 46–49.

HRNČÁR, C. – WEIS, J. – PÁL, G. – BARAŇSKA, B. – BUJKO, J. – MINDEK, S. 2010. The comparison of growth ability breed Oravka with other dual purpose breeds of hens. *Scientific Papers: Animal Science and Biotechnologies*, vol. 43, 2010, p. 1–3.

JATOI, A. S. – IQBAL, M. – SAHOTA, A. W. – AKRAM, M. – JAVED, K. – JASPAL, M. H. – MEHMOOD, S. – HUSSAIN, J. – HAMMED, T. – KHAN, M.S. – ABBAS, Y. – AHMAD, S. – ISHAQ, H. M. 2014. Comparative growth performance in four varieties of native Assel chicken maintained in Pakistan. *Pakistan Journal of Zoology*, vol. 46, 2014, p. 1565–1571.

MALÍK, V. – MALÍKOVÁ, B. 1993. Chov hrabavej hydiny. Dunajská Streda: Animapres, 1995, p. 54–63. ISBN 80-85567-10-5.

MCCREA, B. A. – MILLS, A. F. – MATTHEWS, K. – HUTSON, J. 2014. Performance and carcass characteristics of Delaware chicken in comparison with broilers. *The Journal of Applied Poultry Research*, vol. 23, 2014, p. 586–592.

OLIVIERA, H. N. – LOBO, R. B. – PEREIRA, C. S. 2000. Comparacao de modelos nao-lineares para descrever o crescimento de femeas da raca Guzera. *Pesquisa Agropecuária Brasileira*, vol. 35, 2000, p. 1843–1851.

SAS Institute Inc. 2009. SAS/STAT® 9.2 User's Guide, Second Edition, Cary, NC USA

SIEGMANN, O. – NEUMANN, U. 2005. Kompendium der Geflügelkrankheiten. 6. aktualisierte und erweiterte Auflage. Schluchtersche Verlagsgesellschaft mbH and Co. KG, Hannover, 2005, 365 p. ISBN 3-87706-744-1.

SMITH, D. P. – NORTHCUTT, J. K. – STEINBERG, E. L. 2012. Meat quality and sensory attributes of a conventional and a Label Rouge-type broiler strain obtained at retail. *Poultry Science*, vol. 91, 2012, p. 1489–1495.

SOKOLOWICZ, Z. – KRAWCZYK, J. – SWIATKIEWICZ, S. 2016. Quality of poultry meat from native chicken breeds – a review. *Annals of Animal Science*, vol. 16, 2016, p. 347–368.

WALLEY, K. – PARROT, P. – CUSTANCE, P. – MELEDO – ABRAHIM, P. – BOURDIN, A. 2015. A review of French consumers purchasing patterns, perceptions and decision factors for poultry meat. *World's Poultry Science Journal*, vol. 71, 2015, p. 5–14.

YIN, H. D. – GILBERT, E. R. – CHEN, S. Y. – WANG, Y. – ZHANG, Z. C. – ZHAO, X. L. – ZHANG, Y. – ZHU, Q. 2013. Effect of hybridization on carcass traits and meat quality of Erlang mountainous chickens. *Asian-Australasian Journal of Animal Sciences*, vol. 26, 2013, p. 1504–1510.

YOUSSAO, A. K. I. – SENOU, M. – DAHOUDA, M. – KPODEKON, T. M. – DJENONTIN, J. – IDRISSOU, N.-D. – BONOU, G. A. – TOUGAN, U. P. – AHOUNOU, S. – ASSOGBA, H. M. – BANKOLE, E. – ROGNON, X. – TIXIER-BOICHARD, M. 2009. Genetic improvement of local chickens by crossing with the Label Rouge (T55*SA51): Growth performances and heterosis effects. *International Journal of Poultry Science*, vol. 8, 2009, p. 536–544.

ZHAO, Z. – LI, S. – HUANG, H. – LI, C. – WANG, Q. – XUE, L. 2015. Comparative study on growth and developmental model of indigenous chicken breeds in China. *Open Journal of Animal Sciences*, vol. 5, 2015, p. 219–223.