THE INFLUENCE OF THE AGE OF LAYING HENS ON THE DAILY FEED CONSUMPTION PER LAYING HEN AND EGG

Tatjana KRAJIŠNIK[1*], Miroslav LALOVIĆ[1], Jelena NIKITOVIĆ[2]

[1]Department of Animal Husbandry and Veterinary, Faculty of Agriculture, University of East Sarajevo, East Sarajevo, Bosnia and Herzegovina
[2]University of Banja Luka, Institute of Genetic Resources, Bosnia and Herzegovina
*Corresponding author: tatjana.krajisnik@pof.ues.rs.ba

Abstract

Feed consumption is one of the most essential parameters of the poultry production, because the costs of nutrition often make over 60% of the total cost. Today's light line hybrids, selected for the production of eggs for consumption, realize exceptional conversion of food to egg mass. From an economic point of view, the information about feed consumption per product unit, i.e. produced egg, is more interesting in relation to the daily consumption of food per laying hen, which is not the best indicator of economic production. Since it has been established in the area of the Balkans, that commercial flocks in the production of the eggs are held to the end of the 72nd week of age as a final instance in the production, the aim of this paper is to examine what is going on with feed consumption per hen, and produced egg, before, as well as, after established 72nd week of age, up until the end of the 79th week of age of hen hybrids Lohmann Brown, where the production period lasted 61 weeks, which is 427 days. The examinations were performed on the light line hybrid Lohmann Brown by conducting appropriate experiment on the laying hens' farm "Agrovet" in Foča municipality, Bosnia and Herzegovina – Entity of Republic of Srpska. During the research, the following basic indicators were tested: food consumption (daily per laying hen and per produced egg) by weeks and for the entire production cycle. We also determined the coefficients of phenotype correlation between the age and daily feed consumption per laying hen, or per produced egg. By calculating the phenotypic correlation between the age of laying hens, and the daily feed consumption per laying hen and produced egg, it can be concluded that, in the present case, it is justified to use laying hen in the production of eggs for 61 weeks. Viewed as a whole, it can be concluded that the analyzed commercial flock of light line hybrids Lohmann Brown, in most tracked production indicators has achieved satisfactory results which values are mostly within the limits of the values to the technological standards predicted by selector.

Keywords: *eggs for consumption, feed consumption per laying hen, feed consumption per produced egg, correlation.*

Introduction

Food consumption is one of the most essential parameters of the poultry production, because the costs of nutrition often make over 60% of the total cost. Today's light line hybrids, selected for the production of eggs for consumption, realize exceptional conversion of food to egg mass, which is on the verge of reaching its biological maximum (Rakonjac, 2017). Pandurević et al. (2016) think that, from an economic point of view, the most interesting information is about feed consumption per unit of product, i.e. per produced egg. Also, feed consumption per one egg depends on the mass of the egg, the bigger the egg, the bigger is feed consumption, in addition to all other factors equal, and vice versa. On the basis of previous observations, the daily consumption of feed per laying hen is not the best indicator

of economic production, and the advantage is given to feed consumption per produced egg. Success in the production of eggs depends on the degree of providing optimal conditions: securing sufficient quantities of high quality feed and water; securing appropriate climate in facilities (temperature, air composition, humidity, illumination); usage the proper equipment, which reduces the possibility of harming the hens and breaking the eggs. Babić (2015) in his work concludes that hens in enriched cages consumed more feed, the feed consumption per egg was bigger, and feed conversion was worse, compared to hens kept in conventional cages. Feed consumption per egg moved around 140 g with laying hens kept in conventional cages, while it amounted to around 150 g in enriched cages. Due to the possibility of moving in cages, the hen spent more energy and feed conversion was worse, i.e. the consumption of feed for a kilo of eggs mass was worse. Pandurević et al. (2016) conclude that the average daily consumption of feed during the period of egg production (20-72 week of age) amounted to 126.97 g per laying hen, and 151.47 g per produced egg. The maximum daily consumption of feed per laying hen amounted to 139.29 g (50th week of age), and the minimum 112.32 g (20th week of age), while for a specified period of time each laying hens consumed an average of 47 kg of feed. Daily consumption of feed per laying hen gradually increased until the middle of the production cycle, then stagnated, and towards the end, decreased to a certain extent. By the 45th week of age, the strong positive correlation was found between the daily feed consumption and the age of the hen, by the 58th week of age the correlation was very strong, by the 65th week of age correlation was strong, and by the 70th week of age the correlation was weak. Unlike the daily feed consumption per laying hen, the correlation coefficients between the age of laying hens and the consumption of feed per produced egg were negative and statistically significant ($P<0.05$) up to 48th week of age, and after this period there was no statistical significance ($P>0.05$). The analysis of movement of body mass, growth and feed consumption of observed egg-laying hens in the course of the experiment Petričević (2014) concludes that the obtained production results are within the limits of the technological standards for observed provenience Isa Brown (the brown color the shell). Statistical analysis of the data also determined that the examined factors did not show the influence, either individually or collectively, to the consumption of feed. Feed consumption during entire period of the research ranged in the interval from 114.4 g to 116.1 g. Examining the production of eggs for consumption, with hybrids for the production of eggs with brown shell Isa Brown, Pandurević et al. (2016), determined that the daily feed consumption per laying hen amounted to 120.28 g on average, while the average consumption of feed per produced egg was 145.49 g. The obtained results are in accordance with the technological standards of selector of hybrids Isa Brown.

Daily food consumption of 120 g per laying hen as well as 144.5 g of feed per egg, were obtained with hybrids for the production of eggs with brown shell Hisex Brown, Gjorgovska et al. (2016). Since it was established in the area of the Balkans, that commercial flocks in the production of the eggs are held to the end of the 72nd week of age, as a final instance in the production, the aim of this paper is to examine what is going on with feed consumption per hen before and after established 72nd week of age. In this paper we talk about a period of seven weeks longer, up until the end of the 79th week of age of hen hybrids Lohmann Brown, where the production period lasted 61 weeks, which is 427 days.

Material and Methods

As the initial material for the research, we used 7.720 hens of light line hybrids Lohmann Brown, placed into the facility on the farm "Agrovet" Foča, with at least 18 weeks of age, i.e. the experiment started in the 19th week of age of laying hens. The production period lasted for 61 weeks (the age of the laying hens 79 weeks). A farm for the production of eggs for

consumption on which the experiment was performed uses a classic battery (cage) system to accommodate hens. In the course of raising (exploitation) of the commercial flocks, a technology proposed by the selector of laying hens hybrid was used (http://www.ltz.de). All technological phases (feeding, power, temperature, lighting, ventilation, drainage system and collecting the eggs) are automatically regulated. According to the recommendations of the selector (http://www.ltz.de), the breeder of a line of light hybrids Lohmann Brown, the forage during the production cycle should contain from 2,750 to 2.800 kcal ME and 17.5% of crude protein (load capacity below 5%), or 2,800 kcal ME and about 18% of crude protein (capacity over 5%). During the exploitation of commercial flocks of laying hens, the special attention was paid to four production phases: 27th week of age - WA27 ("a peak" – the maximum produced eggs), 46th week of age - WA46 (mid production cycle), 72nd week of age - WA72 (the usual end of the production cycle) and 79th week of age of laying hens (the end of the production cycle of laying hens in the experiment). In the course of the duration of experiment, the following indicators are examined: feed consumption (per laying hen and per produced egg) by the weeks and for the entire production cycle (61 weeks) from 19th to 79th week of age of laying hens (WA19 - WA79). In order to determine the consumption of feed, the records are kept on daily basis. Based on the data, i.e. by dividing the weekly food consumption with a number of laying hens, then obtained quotient with the number seven, and then multiplying with 1,000, the average daily food consumption per laying hen (g) was calculated. Weekly feed consumption per laying hen (g) was calculated by dividing weekly food consumption with the number of laying hens, and multiplying the obtained result with 1.000. Based on the weekly food consumption and the number of produced eggs, the feed consumption (g) for the production of one egg is calculated. On the basis of the obtained data, the appropriate database was established. The software package SPSS-Statistical Package for Social Sciences (http://spss.en.softonic.com/) was used for statistical analysis. Based on the obtained results, the phenotypic correlation between the age of commercial flocks of laying hens and the daily feed consumption per laying hen and per produced egg, have been established and tested. The power of the phenotype correlation was discussed on the basis of the Roemer-Orphal`s classification (Latinović, 1996).

Results and Discussion

The total amount of consumed feed per weeks of the production during the entire production cycle, then daily and weekly feed consumption per laying hen, as well as the feed consumption per produced egg is presented in the table 1.

Table 1. Feed consumption per weeks of production during the production cycle.

Weeks of age/production	Total amount of feed (kg)	Weekly per laying hen (g)	Daily per laying hen (g)	Weekly eggs per laying hen	Feed per laying hen (g)
$WA_{19/1}$	5,460	707.25	101.04	2.01	351.87
$WA_{20/2}$	5,600	725.39	103.63	4.36	166.37
$WA_{21/3}$	5,600	725.39	103.63	4.36	166.37
$WA_{22/4}$	5,670	743.46	104.92	6.27	117.14
$WA_{23/5}$	5,740	743.52	106.22	6.58	113.00
$WA_{24/6}$	5,780	748.70	106.96	6.63	112.93
$WA_{25/7}$	5,800	751.30	107.33	6.63	113.32
$WA_{26/8}$	5,840	756.48	108.07	6.57	115.14
$WA_{27/9}$	5,880	761.66	108.81	6.63	114.88
$WA_{28/10}$	5,920	766.84	109.55	6.55	117.08

$WA_{29/11}$	5,950	770.73	110.10	6.52	118.21
$WA_{30/12}$	6,000	777.20	111.03	6.53	119.02
$WA_{31/13}$	6,050	783.68	111.95	6.52	120.20
$WA_{32/14}$	6,090	788.86	112.69	6.52	120.99
$WA_{33/15}$	6,120	792.75	113.25	6.50	121.96
$WA_{34/16}$	6,140	795.34	113.62	6.45	123.31
$WA_{35/17}$	6,160	797.93	113.99	6.42	124.29
$WA_{36/18}$	6,160	797.93	113.99	6.36	125.46
$WA_{37/19}$	6,200	803.11	114.73	6.33	126.87
$WA_{38/20}$	6,200	803.11	114.73	6.33	126.87
$WA_{39/21}$	6,230	806.99	115.28	6.32	127.69
$WA_{40/22}$	6,230	806.99	115.28	6.28	128.50
$WA_{41/23}$	6,260	810.88	115.84	6.24	129.95
$WA_{42/24}$	6,300	816.06	116.58	6.25	130.57
$WA_{43/25}$	6,300	816.06	116.58	6.17	132.26
$WA_{44/26}$	6,265	811.53	115.93	6.00	135.26
$WA_{45/27}$	6,230	806.99	115.28	5.98	134.95
$WA_{46/28}$	6,160	797.93	113.99	6.18	129.12
$WA_{47/29}$	6,160	797.93	113.99	6.17	129.32
$WA_{48/30}$	6,120	792.75	113.25	6.16	128.69
$WA_{49/31}$	6,090	788.86	112.69	6.13	128.69
$WA_{50/32}$	6,090	788.86	112.69	6.07	129.96
$WA_{51/33}$	6,055	784.33	112.05	6.07	129.21
$WA_{52/34}$	6,055	784.33	112.05	6.03	130.07
$WA_{53/35}$	6,020	779.79	111.40	6.08	128.25
$WA_{54/36}$	6,020	779.79	111.40	6.02	129.53
$WA_{55/37}$	6,020	779.79	111.40	6.02	129.53
$WA_{56/38}$	5,985	775.26	110.75	5.98	129.64
$WA_{57/39}$	5,950	770.73	110.10	5.97	129.10
$WA_{58/40}$	5,950	770.73	110.10	5.94	129.75
$WA_{59/41}$	5,940	769.43	109.92	5.85	131.53
$WA_{60/42}$	5,950	770.73	110.10	5.81	132.66
$WA_{61/43}$	5,960	772.02	110.29	5.83	132.42
$WA_{62/44}$	5,950	770.73	110.10	5.78	133.34
$WA_{63/45}$	5,915	766.19	109.46	5.70	134.42
$WA_{64/46}$	5,930	768.13	109.73	5.68	135.24
$WA_{65/47}$	5,900	764.25	109.18	5.67	134.79
$WA_{66/48}$	5,870	760.36	108.62	5.66	134.33
$WA_{67/49}$	5,840	756.48	108.07	5.60	135.09
$WA_{68/50}$	5,840	756.48	108.07	5.49	137.79
$WA_{69/51}$	5,820	753.89	107.70	5.50	136.82
$WA_{70/52}$	5,820	753.89	107.70	5.45	138.33
$WA_{71/53}$	5,800	751.30	107.33	5.39	139.39
$WA_{72/54}$	5,780	748.70	106.96	5.30	141.00
$WA_{73/55}$	5,720	740.93	105.85	5.22	141.94
$WA_{74/56}$	5,700	738.34	105.48	5.26	140.37
$WA_{75/57}$	5,680	735.75	105.11	5.18	142.04
$WA_{76/58}$	5,660	733.16	104.74	5.03	145.76

$WA_{77/59}$	5,640	730.57	104.37	4.93	148.19
$WA_{78/60}$	5,640	730.57	104.37	4.90	149.10
$WA_{79/61}$	5,620	727.98	104.00	4.95	147.07
Average	362,825	770.46	110.07	5.88	134.18

When it comes to the total consumption of feed per laying hen, we can see a constant increase in the feed consumption until WA43/25, after which comes to the phased reduction of feed consumption until the end of the production (WA79/61), with three oscillations in the 60th, 61st and 64th week of age of laying hen, when we noticed a slight increase in feed consumption compared to previous week. Table 1 shows that the feed consumption respectively increased and decreased on daily and weekly basis, in a way that feed consumption gradually increased until 43rd week of age, with oscillations in the 60th, 61st and 64th week of age, which were characteristic for the total feed consumption. Then the feed consumption on a daily and weekly level continued to decline until the end of the production cycle (WA79/61). During the experiment, an average 5.88 eggs were produced per laying hen a week, while it was spent on average 134.18 grams of feed for producing one egg. Average daily feed consumption per laying hen was 110.07 g, while it was spent an average of 770.46 g of feed per hen a week. By the end of 72nd week of age of laying hens (the established period up to when the commercial flocks in the production of eggs are held) it was produced an average of 5.99 eggs per laying hen a week, while the average were spent of feed was 132.79 g for one egg. It was spent on average 775.20 g of feed per laying hen a week, while average daily feed consumption per laying hen stood at 110.74 g, which is below the values declared as technology standard of examined hybrid (112.13 g/laying hen). Higher values for average daily feed consumption with hybrids for the production of eggs with brown shell (20-72 week of age) are noted by Milošević (2014) 120 g, Petričević (2014) 115 g, Pandurević et al. (2016), Gjorgovska et al. (2016) 120 g, and with the same hybrid, Pandurević et al. (2016) noted 126.97 g of feed per laying hen.

Higher values for the average feed consumption per produced egg with the same hybrids for the entire period of exploitation of laying hens until 72nd week of age, we can observe with Pandurevic et al. (2016), 151.47 g. Also, the higher values for the average feed consumption per egg with hybrids for the production of brown shell eggs, was found by Babić (2015) 140 g, Pandurević et al. (2016) 145.49 g and Gjorgovska et al. (2016) at 144.5 g of feed per produced egg.

On the basis of the data from table 2, we can see that there is a correlation connection and statistical significance between the age of laying hens, daily food consumption and feed consumption per produced egg.

Table 2. Phenotypic correlation between the age of laying hens, daily food consumption per laying hen (g) and food consumption per egg (g).

Weeks of age/production	Daily per laying hen (g)		Food per egg (g)	
	r_{xy}	Connection	r_{xy}	Connection
32/14	0.990***	Complete	-0.513**	Strong
33/15	0.991***	Complete	-0.490**	Medium
34/16	0.992***	Complete	-0.467**	Medium
35/17	0.991***	Complete	-0.446*	Medium
36/18	0.989***	Complete	-0.425*	Medium
37/19	0.988***	Complete	-0.404*	Medium
38/20	0.985***	Complete	-0.385*	Weak
39/21	0.984***	Complete	-0.367*	Weak

40/22	0.981***	Complete	-0.350*	Weak
41/23	0.980***	Complete	-0.332*	Weak
42/24	0.980***	Complete	-0.315^{ns}	Weak
43/25	0.978***	Complete	-0.297^{ns}	Weak
44/26	0.973***	Complete	-0.277^{ns}	Weak
45/27	0.964***	Complete	-0.259^{ns}	Weak
46/28	0.944***	Complete	-0.251^{ns}	Weak
47/29	0.926***	Complete	-0.243^{ns}	Very weak
48/30	0.902***	Complete	-0.236^{ns}	Very weak
49/31	0.874***	Very strong	-0.230^{ns}	Very weak
50/32	0.848***	Very strong	-0.222^{ns}	Very weak
51/33	0.816***	Very strong	-0.217^{ns}	Very weak
52/34	0.787***	Very strong	-0.210^{ns}	Very weak
53/35	0.752***	Very strong	-0.206^{ns}	Very weak
54/36	0.719***	Strong	-0.201^{ns}	Very weak
55/37	0.689***	Strong	-0.196^{ns}	Very weak
56/38	0.653***	Strong	-0.191^{ns}	Very weak
57/39	0.611***	Strong	-0.187^{ns}	Very weak
58/40	0.572***	Strong	-0.182^{ns}	Very weak
59/41	0.534***	Strong	-0.176^{ns}	Very weak
60/42	0.500***	Strong	-0.169^{ns}	Very weak
61/43	0.471***	Medium	-0.162^{ns}	Very weak
62/44	0.441***	Medium	-0.155^{ns}	Very weak
63/45	0.406**	Medium	-0.147^{ns}	Very weak
64/46	0.376**	Weak	-0.139^{ns}	Very weak
65/47	0.342*	Weak	-0.132^{ns}	Very weak
66/48	0.303*	Weak	-0.125^{ns}	Very weak
67/49	0.261*	Weak	-0.118^{ns}	Very weak
68/50	0.223^{ns}	Very weak	-0.109^{ns}	Very weak
69/51	0.182^{ns}	Very weak	-0.101^{ns}	Very weak
70/52	0.145^{ns}	Very weak	-0.092^{ns}	Missing
71/53	0.107^{ns}	Very weak	-0.082^{ns}	Missing
72/54	0.068^{ns}	Missing	-0.072^{ns}	Missing
73/55	0.022^{ns}	Missing	-0.060^{ns}	Missing
74/56	-0.023^{ns}	Missing	-0.051^{ns}	Missing
75/57	-0.068^{ns}	Missing	-0.041^{ns}	Missing
76/58	-0.111^{ns}	Very weak	-0.028^{ns}	Missing
77/59	-0.153^{ns}	Very weak	-0.013^{ns}	Missing
78/60	-0.191^{ns}	Very weak	0.002^{ns}	Missing
79/61	-0.227^{ns}	Very weak	0.014^{ns}	Missing

Correlation coefficients showed that the association between age of laying hens, and the daily feed consumption from WA32/14 to WA48/30 is complete, from WA49/31 to WA53/35 very strong, from WA54/36 to WA60/42 strong, from WA61/43 to WA63/45 medium strength, and from the WA64/46 to WA79/61 is very weak, weak or missing. The phenotypic correlation from WA32/14 to WA67/49 is positive and statistically significant, and up to WA62/44 it is statistically very highly significant ($p<0.001$), in WA64/45 and WA63/46 it is highly significant ($r<0.01$), and at the 65th, 66th and 67th week of age of laying hen

correlation is significant ($r<0.05$). From WA68/50 to WA73/55 correlation is a positive, but not statistically significant, while from WA74/56 correlation is negative and not statistically significant. When it comes to phenotypic correlation coefficient between the age of laying hens, and feed consumption per produced egg, a connection up to WA34/16 was negative and highly significant ($r<0.01$), from WA35/17 to WA41/23 was negative and statistically significant ($p<0.05$), while from WA42/24 to WA79/61 was negative, but without statistical significance ($p>0.05$), table 2. Similar results in her work noted Pandurević Tatjana (2011), who has found negative correlation between the age of laying hens hybrid Lohmann Brown and feed consumption per produced egg from 22nd to 53rd week of production, as the correlation connection was determined between the age of laying hens and daily feed consumption, was positive and significant at the level of the $R<0.05$; $R<0.01$ and $R<0.001$.

Conclusions

When it comes to the total consumption of feed per laying hen, we can see a constant increase in the feed consumption until WA43, after which comes to the phased reduction of feed consumption until the end of the production (WA79), with three oscillations in the 60th, 61st and 64th week of age of laying hen, when we noticed a slight increase in feed consumption compared to previous week. During the experiment, an average 5.88 eggs were produced per laying hen a week, while it was spent on average 134.18 grams of feed for producing one egg. Average daily feed consumption per laying hen was 110.07 g, while it was spent an average of 770.46 g of feed per hen a week. By the end of 72nd week of age of laying hens (the established period up to when the commercial flocks in the production of eggs are held) it was produced an average of 5.99 eggs per laying hen a week, while the average were spent of feed was 132.79 g for one egg. It was spent on average 775.20 g of feed per laying hen a week, while average daily feed consumption per laying hen stood at 110.74 g, which is below the values declared as technology standard of examined hybrid. Correlation coefficients showed that the association between age of laying hens, and the daily feed consumption to WA48 is complete, from WA49 to WA53 very strong, from WA54 to WA60 strong, from WA61 to WA63 medium strength, and from the WA64 to WA79 is very weak, weak or missing. The phenotypic correlation to WA67 is positive and statistically significant ($p<0.001$; $p<0.01$; $p<0.05$), from WA68 to WA73 is positive, but not statistically significant, while from WA74 is negative and not statistically significant. When it comes to phenotypic correlation coefficient between the age of laying hens, and feed consumption per produced egg, a connection up to WA34 was negative and highly significant ($r<0.01$), from WA35 to WA41 was negative and statistically significant ($p<0.05$), while from WA42 to WA79 was negative, but without statistical significance ($p>0.05$).

By calculating the phenotypic correlation connection between the age of laying hens, and the daily food consumption per laying hen and per produced egg, it can be concluded that in the present case it is justified to use laying hen in the production of eggs for consumption for 61 weeks. Viewed as a whole, it can be concluded that the analysed commercial flock of light line hybrids Lohmann Brown, in most tracked production indicators achieved satisfactory results whose values are mostly within the limits of the values to the technological standards predicted by selector.

References

Babić S. (2015). Influence of enriched cages on the sustainability of table egg production on the family farm KONES-BI D.O.O. Final specialist graduate thesis, College of Economics in Križevci, Republic of Croatia, Križevci.

Gjorgovska N., Filev K., Levkov V., Gjorgjievski S., Kostov V., Nastova R. (2016). The effect of feed rich in dha on egg production, egg components and dha content in yolk. Bulgarian Journal of Agricultural Science 22 (Supplement 1), 10-14 p.

Latinović D. (1996). Population genetics and breeding of domestic animals. Practicum, University of Belgrade, Faculty of Agriculture, Belgrade.

Pandurević T. (2011). Influence of age on productivity, quality and chemical composition of eggs of light linear hybrid hens. Doctoral thesis. Faculty of Agriculture, East Sarajevo.

Pandurevic T., Mitrovic S., Lalovic M., Mojevic M., Rankic I. (2016). Influence of litter age on daily food consumption per litter and egg. XXI Conference on Biotechnology, Proceedings vol. 21 (24), 505-512 pp., Čačak.

Pandurevic T., Mitrovic S., Mojevic M., Rankic I. (2016). Analysis of technology and results of production of eggs for consumption on the farm "Natura". XXI Conference on biotechnology, Proceedings, vol. 21 (24), 571-576 pp., Čačak.

Petričević V. (2014). Production results of fattening chickens and laying hens fed with mixtures with different participation of raw soybeans. Doctoral thesis. University of Belgrade, Faculty of Agriculture, Belgrade-Zemun.

Rakonjac S., Bogosavljevic-Boskovic S., Skrbic Z., Peric L., Doskovic V., Petricevic V., Petrovic M., (2017). Internal quality of laying hen eggs from different breeding systems. XXII Conference on Biotechnology, Proceedings, Book 2, 685-690 pages, Čačak.

http://www.ltz.ba (Leyer managament program Lohmann Brown. Lohmann Tierzucht G. M. B. H., Cuxhaven Germany)

http://spss.en.softonic.com (SPSS - Statistical Package for Social Sciences)