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EGG PRODUCTION FROM DUAL PURPOSE HEN GENOTYPES REARED IN A FREE RANGE SYSTEM

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Abstract

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Egg production until 52 weeks of age was investigated in six chicken genotypes of various origin: Tetra H and Tetra Super Harco (two hybrids produced by Bábolna Tetra Kft., Hungary), line G (White Plymouth Rock) and line E (Barred Plymouth Rock) from the National Gene Pool and two introduced breeds (Bielefelder and Australorp) in two replications. The birds of each group (27 ♀ and 3 ♂) were reared in a free-range system with outdoor access to walking yards. The highest egg production, best feed conversion per egg produced in both experiments were demonstrated in Tetra Super Harco hybrid, followed by the two lines of the National Gene Pool G and E, Australorp, Tetra H and finally, Bielefelder.

Key words: dual purpose hen; egg; free range poultry; genotype; morphological characteristic

Introduction

At present, the problem with rearing domestic livestock and birds in conditions as closest to their requirements and free of stress is becoming particularly important. To this end, the free range systems for chickens with outdoor access to yards offer more possibilities for movement and allows performing natural behavioural reactions. On the other hand, free range systems are accompanied with higher risk from viral, parasitic infections and attacks from predators (Henry, 2002; Miao et al., 2005; Oberholtzer et al., 2006; Alhaji and Odetokun, 2011), feather pecking and cannibalism (Keeling et al., 1988; Armstrong and Cermak, 1989; Blokhuis and Beutler, 1992), discomfort caused by changing environmental temperatures (Lin et al., 2006). In organic production systems, the selection of the suitable genotype (breed, line, hybrid) is especially important. Local fowl are increasingly preferred for organic farms, particularly dual-purpose ones as they are more resistant to various diseases and to changing meteorological conditions in the environment (Koelkebeck and Cain, 1984; Rizzi and Chiericato, 2005).

The aim of the present experiments was to investigate egg production of various dual-purpose chicken genotypes in free-range systems with walking yards access.

Materials and Methods

Birds and rearing

Two identical consecutive experiments were performed in the poultry farm of the Agricultural University – Plovdiv: the first in 2014-2015 and the other – in 2015-2016, to study the egg production of six dual purpose hen genotypes: Tetra H (Group 1) and Tetra Super Harco (Group 2) – hybrid combinations produced by Bábolna Tetra Kft. (Hungary), two lines from the National Gene Pool: line G (White Plymouth Rock, Group 3) and line E (Barred Plymouth Rock, Group 4), and two breeds introduced for the first time in Bulgaria by breeder eggs import; Bielefelder (Group 5) and Australorp (Group 6). Each group included 27 hens and 3 cocks. Within a replication, all birds were at the same age, and reared in equal conditions in sleeping pens and outdoor walking yards i.e. in a free range system.

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The sleeping pens were identical (size 3.50/2.50/2.75 m) equipped with 3 perches, 2.50 m in length, and 8 two-floor wooden nest boxes of 30/30/40 cm each. The housing density of poultry in sleeping pens was 3.43 birds per 1 m^2 area. The light intensity coefficient in sleeping pens was about 55 lx (1:12 ratio of window area to floor area).

On the bottom of the southern wall of pens, there was a 30/40 cm rectangular opening for outdoor access. Each yard was 9.20/24 m of size with perennial broadleaf trees in the middle. The housing density of birds in walking yards was 0.14 birds/m^2 i.e. 7.36 m^2 per bird. Each group was provided with two tube feeders, placed under the eaves of sleeping houses and with watering troughs ensuring feeding and drinking widths of 10 and 3 cm per bird, according to the requirements of Regulation 44/2006.

The fowl were fed *ad libitum* with the same compound feed according to the laying period. The ingredients and nutrient analysis of the diets are shown in Table 1.

Egg production and egg quality traits

Egg production was monitored from the age at first egg (AFE) to 52 weeks of age (in % weekly). The eggs were collected daily and the total number recorded with respect to the group.

– Egg measurements were performed once a week (in control day) by determining the following parameters for each egg individually:

– Egg weight – with accuracy ± 0.01 g, with electronic scale OHAUS (Japan);

– Total egg mass up to 52 weeks of age (TEM_{52}) – total number of eggs x egg weight (kg)

– Egg shape index – by the formula $I = \frac{B}{L}.100$ (in %), where B is maximum breadth (mm) and L is egg length (mm), with a caliper and accuracy ± 1 mm;

– Shell weight, egg yolk and egg albumen – with accuracy ± 0.01 g, with electronic scale OHAUS, and respectively percentages of egg shell or egg yolk or egg albumen weight vs. egg weight.

Table 1
Composition of the diet

Feed ingredients in %	Laying period in week			
	17-18 Prelaying period	19-28 First phase	29-40 Second phase	41-52 Third phase
Corn yellow	33.67	30.82	30.82	32
Wheat	33.67	32.82	30.82	32.08
Soybeans toast (44% CP)	12	12.5	12	10
Sunflower expeller (34% CP)	15	15	15	15
Sunflower oil	-	1.2	0.5	-
L-lysine	0.11	0.07	0.01	0.05
DL-Methionine	0.07	0.09	0.07	0.07
Sodium chloride	0.26	0.28	0.23	0.20
Limestone	3.8	8.2	9.7	10
Dicalcium phosphate	1.2	0.7	0.53	0.38
Premix TB 301 Layers	0.2	0.2	0.2	0.2
Synergine	0.02	0.02	0.02	0.02
Nutrient analysis				
Metabolizable energy, MJ/kg	12.1	11.8	11.5	11.5
Crude protein, %	17.8	17.4	17.1	16.5
Crude fiber, %	4.5	4.4	4.4	4.3
Crude fats, %	4.1	5.1	4.4	4.00
Calcium %	2	3.6	3.81	3.92
Phosphorus available, %	0.66	0.56	0.53	0.3
Lysine,%	0.85	0.81	0.75	0.73
Methionine+cysteine,%	0.73	0.73	0.70	0.69

Premix TB 301 Layers (made in De Heus Koudijs Animal Nutrition The Netherlands) in 1 kg contains: vitamin A (3a672a) – 5000000 IU; vitamin D3 (E 671) – 1500000 IU; vitamin E (3a700) – 4000 mg; vitamin K3 – 500 mg; vitamin B1 – 250 mg; vitamin B2 – 1500 mg; calcium-D-pantothenate (3a841) – 3000 mg; vitamin PP (3a315) – 10000 mg; vitamin B6 (3a831) – 500 mg; vitamin B9 folic acid (3a316) – 250 mg; vitamin B12 – 10000 mg; vitamin B4 (3a890) – 50000 mg; Fe – 20000 mg; I – 400 mg; Cu – 2300 mg; Mn – 32500 mg; Zn – 25000 mg; Se – 125 mg; antioxidants: propyl gallate (E 310) – 41.7 mg; BHT (E 321) – 41.7 mg; ethoxycuine (E 324) – 41.7 mg; preserving agent: citric acid (E 330) – 0.1 g

– Shell thickness – with accuracy ±1 µm, with a micrometer screw gauge at the pointed end (sharp), at the blunt end (air cell) and at the equatorial part (the wide shell thickness)

– Colour of egg yolk – determined with a Roche yolk colour fan scale

– Yolk index – formulated as (yolk height/yolk diameter) × 100

– Albumen index – formulated as (albumen height/(albumen length + albumen width)/2) × 100

– Haugh unit value (HU) – by the formula of Haugh (1937)

– HU = $100\log(H - 1.7W^{0.37} + 7.6)$ where H is height of albumen (mm) and W is egg weight (g)

Results and Discussion

Age at first egg

During the first and the second experiments, Tetra Super Harco pullets began laying eggs on the earliest, followed by Tetra H pullets – at 116 and 117 days of age, respectively (17 weeks of age) during the first and at 128 days of age (19 weeks) and 130 days of age (20 weeks) during the second replication. The hens from the German breed Bielefelder began laying at the highest age: 210 days of age (30 weeks) and 205 days of age (29 weeks) – Table 2. In general, the ranking of ages of first egg of pullets from the six genotypes were the same in both replications except for both lines of the National Gene Pool whose ranks were changed.

In our rearing conditions, both Hungarian hybrids began laying eggs at an earlier age as compared to recommendation of the manufacturer Bábolna Tetra Kft (http://www.babolna-tetra.com) e.g. 22 weeks of age. The pullets of lines G and E also exhibited lower age at first eggs as reported by Lalev et al. (2012): 180 and 182 days of age, respectively. In our view, the most probably cause was the *ad libitum* feeding leading to earlier sexual maturation. During the second experimental year, Bielefelder pullets also began laying at the oldest age (Table 2).

Egg production

During the first replication, the highest number of eggs was observed in Tetra Super Harco pullets – 63.28% (158.97 eggs per bird), and the lowest one: in Bielefelder – 37.87% (58.31 eggs/bird) – Table 3. The total feed intake for the Tetra Super Harco hybrid throughout the entire rearing period, 52-week feed intake and daily feed intake were among the highest recorded, while Bielefelder pullets demonstrated one of the lowest values. The line G, line E and Australorp pullets had comparable number of laid eggs per bird, feed intake and feed conversion per egg. These three genotypes,, although characterised with almost equal number of eggs per bird, differed in egg production percentages due to the different age at first egg.

The feed intake of Tetra H pullets was among the highest recorded (for the entire period and daily values). This is the group with higher feed conversion ratio due to the relatively high feed intake and lower number of produced eggs (5th rank among the 6 genotypes).

During the second experiment, egg production percentages were higher in all studied genotypes except for Australorp: Тетра H – by 13.65 % (+ 11.41 eggs); Tetra Super Harco – by 11.65 % (–3.37 eggs due to higher AFE by 12

Table 2
Beginning of egg lay

Genotype	Experiment			
	I		II	
	age at first egg, in days date	rank	age at first egg, in days date	rank
Tetra H	117 21.10.2014	2	134 22.11.2015	2
Tetra Super Harco	116 20.10.2014	1	128 16.11.2015	1
Line G (White Plymouth Rock)	146 19.11.2014	3	148 06.12.2015	4
Line E (Barred Plymouth Rock)	156 29.11.2014	4	146 04.12.2015	3
Bielefelder	210 23.01.2015	6	205 27.01.2016	6
Australorp	166 09.12.2014	5	170 27.12.2015	5

Note: Birds included in the first replication were hatched on 28 June 2014, and those from the second one: on 10 July 2015

Table 3
Egg production up to 52 weeks of age and feed intake

Genotype	Egg production,		Total feed intake for 52 weeks, kg	Daily feed intake, g	Feed conversion ratio feed/egg, g
	%	Total eggs/hen			
Experiment I					
Tetra H	41.06	103.48	50.825	159.05	387.33
Tetra SH	63.28	158.97	51.447	168.69	267.41
Line G	54.18	121.37	47.712	157.07	289.90
Line E	57.69	121.16	45.445	158.98	275.57
Bielefelder	37.87	58.31	36.559	129.19	339.56
Australorp	58.89	119.54	44.606	160.83	272.61
Experiment II					
Tetra H	54.71	114.89	47.795	154.60	282.59
Tetra SH	74.93	155.60	44.034	148.84	198.64
Line G	67.18	140.81	45.674	153.51	228.52
Line E	64.96	142.88	43.479	151.83	222.64
Bielefelder	51.93	87.25	34.195	112.65	216.91
Australorp	52.72	103.33	37.221	130.33	247.20

days); line G – by 13.00 % (+ 19.44 eggs); line E – by 7.27% (+ 21.72 eggs); Bielefelder – by 14.06 % (+ 28.94 eggs); Australorp – by –6.17 % (-16.21 eggs).

In both experiments, the highest egg production was noted in the Tetra Super Harco hybrid, followed by the two lines from the National Gene Pool (E and G), the Tetra H hybrid and finally, by Australorp and Bielefelder breeds. According to Tůmová et al. (2007) the number of laid eggs and egg weight were influenced highly significantly (P≤0.001) by the genotype. The arrangement of genotypes with regard to feed conversion per egg was the same except for the Bielefelder pullets. During the second replication, the six genotypes exhibited lower 52-week feed intake. Lower daily feed intakes as well as daily feed intake during the lay period were also observed. We suggested that this was due to environmental conditions, which had a substantial impact to egg production as well as on consumption and conversion of the diet.

Egg morphology

During the first experiment, eggs produced by line E (Barred Plymouth Rock) were outlined with the highest egg weight followed by eggs produced by Bielefelder, Tetra Super Harco, Australorp and ultimately, Tetra H (Table 4). The difference in egg weight between the first and last ranked genotypes was 5.86 g (P<0.001). In the second replication, the highest egg weight was that of line G, and the lowest – again in Tetra H – difference of 3.41 g (P<0.001).

In both experiments, Tetra Super Harcopullets gave the highest TEM_{52} (9.146 kg and 9.124 kg, respectively), followed by both lines from the National Gene Pool: line G (7.016 kg and 8.354 kg) and E (7.383 kg and 8.311 kg), Australorp (6.875 kg and 5.966 kg), Tetra H (5.700 kg and 6.425 kg) and finally Bielefelder (3.388 kg and 4.938 kg).

Egg morphology was determined by the proportions of the three main components of eggs: eggshell, yolk and albumen. Absolute and relative eggshell weights of all genotypes were statistically significantly lower during the second experiment as compared to the first one (P<0.001). The causes could be hardly identified. The comparative analysis showed that the highest absolute (g) and relative (%) yolk weights were obtained in lines G and E, as well as in the Tetra H hybrid. Yolk weight varied from 27.20% in Bielefelder to 28.80% in line G. Bielefelder eggs had the lowest relative content of egg yolk and highest of albumen vs all other genotypes. Albumen weight varied from 59.85% in Tetra H to 62.64% in Bielefelder eggs.

The egg shape index varied from 74 to 78% e.g. the ratio of the small to the big diameter was 3:4. Lower egg shape index values showed that eggs were more elongated, as were those produced by the breed Bielefelder –73.32±0.28% and 70.90±0.24% in the first and second experiments, respectively. In all other studied genotypes, egg shape index was between 75.37 and 77.37%. According to Oblakova (2006) and Kaliasheva et al. (2017) the egg shape index did not depend on egg weight, while the genotype influenced significantly this trait. Tůmová et al. (2007) observed significant interactions (P ≤ 0.05) in the egg shape index, which increased with the time of oviposition. Compared to the egg production period, the genotype had a far more pronounced influence on the egg shape in-

Table 4 A
Morphological characterics of eggs

Traits		Experiment	Tetra H	Tetra SH	Line G	Line E	Bielefelder	Australorp
Egg weight	g	I	55.08±0.32	57.53±0.38	57.81±0.42	60.94±0.46	58.10±0.30	57.51±0.43
			$a_{1;}a_{2;}a_{3;}a_{4;}a_5$	$a_{1;}a_6$	$C_1\ a_{2;}a_7$	$A_{1;}\ a_{3;}a_{6;}a_{7;}a_{8;}a_9$	$A_{1;}\ a_{4;}a_8$	$a_{5;}a_9$
	g	II	55.92±0.46	58.64±0.46	59.33±0.48	58.17±0.56	56.62±0.26	57.74±0.43
			$a_{1;}a_{2;}b_{1;}b_2$	$a_{1;}a_3$	$C_{1;}\ a_{2;}a_{4;}c_1$	$A_{1;}\ b_{1;}c_2$	$A_{1;}\ a_{3;}a_{4;}c_{2;}c_3$	$b_{2;}c_{1;}c_3$
Shell weight	g	I	6.08±0.05	6.36±0.06	6.06±0.05	6.17±0.06	6.22±0.05	6.30±0.05
			$A_1\ b_1$	$A_2\ a_1c_1$	$A_3\ a_1a_2c_2$	$A_4\ c_1$	$A_5\ c_2$	$A_6\ a_2\ b_1$
	%		10.82±0.11	11.19± 0.14	10.63±0.11	10.22± 0.13	10.58± 0.10	11.11± 0.13
	g	II	5.50±0.05	5.63±0.05	5.70±0.05	5.66±0.06	5.68±0.05	5.69±0.05
			$A_{1;}\ b_{1;}b_{2;}c_1$	A_2	$A_{3;}\ b_1$	A_4	$A_{5;}\ c_1$	$A_{6;}\ b_2$
	%		9.85±0.06	9.71±0.07	9.62±0.06	9.76±0.08	10.05±0.09	9.87± 0.07
Yolk weight	g	I	16.56±0.16	16.35±0.20	16.59±0.20	17.09±0.22	16.49±0.14	15.56±0.17
			$C_{1;}\ a_1$	b_1	a_2	$a_{3;}c_1$	$A_{1;}\ c_1$	$C_{2;}\ a_{1;}a_{2;}a_{3;}b_1$
	%		28.78±0.14	27.88± 0.20	28.52± 0.22	27.94 ±0.22	27.90±0.22	27.02±0.18
	g	II	15.83±0.25	16.73±0.21	17.02±0.25	16.59±0.24	15.50±0.12	16.07±0.16
			$C_{1;}\ a_{1;}b_{1;}c_1$	$a_{2;}b_{1;}c_2$	$a_{1;}a_{3;}c_3$	$a_{4;}c_1$	$A_{1;}\ a_{2;}a_{3;}a_{4;}b_2$	$C_{2;}\ b_{2;}c_{2;}c_3$
	%		28.30±0.29	28.41±0.24	28.80±0.26	28.37±0.24	27.37±0.16	27.84±0.20
Albumen weight	g	I	34.44±0.25	35.30±0.28	35.16±0.29	37.68±0.31	36.42±0.27	35.64±0.32
			$B_{1;}\ a_{1;}a_{2;}b_{1;}c_1$	$C_{1;}\ a_{3;}b_{2;}c_1$	$A_{1;}\ a_{4;}b_3$	$A_{2;}\ a_{1;}a_{3;}a_{4;}a_{5;}b_4$	$B_{1;}\ a_{2;}b_{2;}b_{3;}b_4$	$a_{5;}b_1$
	%		60.43±0.18	60.93±0.18	60.85±0.18	61.83±0.19	61.52±0.22	61.87±0.18
	g	II	33.39±0.26	36.28±0.29	36.61±0.32	35.94±0.35	35.45±0.20	35.97±0.30
			$B_{1;}\ a_{1;}a_{2;}a_{3;}a_{4;}a_5$	$C_{1;}\ a_{1;}c_1$	$A_{1;}\ a_{2;}b_1$	$A_{2;}\ a_3$	$B_2;\ a_{4;}b_{1;}c_1$	a_5
	%		59.85±0.28	61.94±0.22	61.78±0.32	61.86±0.25	62.64±0.18	62.29±0.19

Note: Number of eggs (n) submitted to morphometry: for Tetra H: n = 209 first year and n = 159 second year; for Tetra Super Harco n = 258 first year and n=178 second year; for line G White Plymouth Rock: n = 169 first year and n= 152 second year; for line E Barred Plymouth Rock: n = 161 first year and n=159 second year; for Bielefelder: n = 94 first year and n = 95 second year; for Australorp: n = 161 first year and n = 126 second year;
$P < 0.001$ – a_1-a_1….a_n- a_n; $P< 0.01$ – b_1-b_1….b_n- b_n; $P < 0.05$ – c_1-c_1….c_n- c_n between genotypes within a row $P < 0.001$ – A_1-A_1….A_n- A_n; $P < 0.001$ – B_1-B_1….B_n- B_n; $P < 0.01$ – C_1-C_1….C_n- C_n between experiment I and II for the same genotype

dex. For instance, Hrnčár et al. (2017) reported decrease of egg shape index in the autochthonous chicken breed Oravka as the laying period progressed (from 75.24% in 26 weeks to 74.16% in 56 weeks of age). The egg shape index has an effect on the embryonic development. Narushin and Romanov (2002) reported that both narrow and more markedly oval egg shapes are likely to impede the rotation of the embryo inside the egg.

The yolk index varied from 43.06% in Bielefelder to 48.78 % in line G, and the albumen index: from 8.52% (line G) to 10.15% (Australorp). In general there were no statistically significant differences between genotypes and values were similar to usual ones. As the intensity of yolk colour was concerned, during the second experiment yolks were with a more intensive yellow colour. Having in mind that the hens were fed compound feed prepared at the farm with uniform composition, the small difference in yolk colour intensity could be attributed either to the subjective factor or to the difference in the content of pigments in the maize utilised in feed production during each of replications.

Haugh units, a parameter of egg freshness, varied from 80.74% in line G to 85.85% in Australorp eggs and were within the usual ranges.

Gerzilov (2011), Mincheva et al. (2011) and Lukanov (2014) reported comparable data in their studies with hens from the National Gene Pool with respect to eggshell, yolk and albumen weight percentages as well as about yolk and albumen index values and Haugh units.

Table 4 B
Morphological characteristic of eggs

Traits		Experiment	Tetra H	Tetra SH	Line G	Line E	Bielefelder	Australorp
Egg shape index		I	75.37±0.20 A1 $a_1a_2a_3b_1$	75.63±0.12 B_1 $a_4a_5a_6b_2$	77.00±0.22 $a_1a_4a_7c_1$	77.37±0.18 B_2 $a_2a_5a_8a_9$	73.32±0.28 A_2 $a_3a_6a_7a_8a_{10}$	76.34±0.24 $a_9a_{10}b_1b_2c_1$
		II	76.57±0.23 A1 a_1	76.18±0.17 B_1 a_2	76.54±0.22 a_3	76.45±0.29 B_2 a_4	70.90±0.24 A_2 $a_1a_2a_3a_4a_5$	76.24±0.28 a_5
Shell thickness , µm	pointed end	I	319±1 a_1a_2	324±1 a_1a_3	317±1 a_3b_1	321±2	323±2 b_1	324±1 a_2
		II	321±1 $a_1a_2a_3a_4$	326±1 $a_1a_5b_1$	357±2 $a_2a_5a_6a_7a_8$	325±2 a_6b_2	329±2 a_3a_7	333±2 $a_4a_8b_1b_2$
	equatorial part	I	307±1 $a_1a_2a_3a_4$	312±1 $a_1a_5b_1c_1$	306±1 $a_5a_6a_7a_8$	312±1 $a_2a_6b_2c_2$	319±2 $a_3a_7b_1b_2$	315±1 $a_4a_8c_1c_2$
		II	311±2 a_1b_1	314±1 a_2b_2	314±2 a_3c_1	314±2 a_4c_2	328±2 $a_1a_2a_3a_4b_3$	320±2 $b_1b_2b_3c_1c_2$
	blunt end	I	309±1 $c_1c_2b_1b_2$	306±1 a_1c_1	305±1 a_2b_1	304±2 a_3c_2	309±2 c_3	315±2 $a_1a_2a_3b_2c_3$
		II	308±2 c_1c_2	306±2 b_1b_2	306±2 b_3b_4	307±2 c_3b_5	314±2 $b_1b_3c_1c_3$	315±2 $b_2b_4b_5c_2$
Yolk index, %		I	46.15±0.26 $a_1b_1b_2c_1$	44.48±0.26 B_2 $a_1a_2c_2$	45.35±0.28 C_2 $c_1c_2b_3$	44.93±0.28 A_3 a_3b_1	44.95±0.34 A_5 a_4b_2	46.27±0.21 $a_2a_3a_4b_3$
		II	46.51±0.34 a_1	45.64±0.29 B_2 $a_2a_3c_1$	48.78±1.38 C_2 $a_4c_1c_2$	47.08±0.27 A_3 $a_2a_5b_1$	43.06±0.32 A_5 $a_1a_3a_4a_5a_6$	45.89±0.32 $a_6b_1c_2$
Colour of egg yolk		I	8.73±0.07 A_1 $a_1a_2c_1$	8.28±0.08 A_2 $a_1a_3b_1c_2$	8.51±0.08 A_{23} c_1c_2	8.73±0.08 A_4 a_3a_4	8.60±0.06 A_5 b_1b_2	8.32±0.08 A_6 $a_2a_4b_2$
		II	9.92±0.12 A_1 $a_1a_2b_1$	9.72±0.15 A_2 b_2	9.43±0.08 A_3 a_1a_3	9.27±0.08 A_4 $a_2a_4b_2$	9.48±0.09 A_5 b_1b_3	9.90±0.10 A_6 $a_3a_4b_3$
Albumen index, %		I	9.18±0.12 C_1 b_1c_1	8.63±0.13 A_1 $a_1b_1b_2c_2c_3$	9.10±0.15 B_1 c_2c_4	9.21±0.14 b_2	9.20±0.19 c_3	9.59±0.16 C_2 $a_1c_1c_4$
		II	9.58±0.16 C_1 a_1c_1	9.93±0.15 A_1 a_2b_1	8.52±0.15 B_1 $a_1a_2a_3a_4a_5$	9.56±0.15 a_3c_2	9.31±0.14 $a_4a_6b_1$	10.15±0.18 C_2 $a_5a_6c_1c_2$
Haugh unit value (HU)		I	83.43±0.39 b_1c_1	81.95±0.43 C_1 $a_1a_2c_1c_2$	83.35±0.46 B_1 b_2c_2	85.07±0.42 $a_1b_1b_2c_3$	83.52±0.66 c_3	84.30±0.42 C_2 a_2
		II	84.43±0.45 a_1c_1	83.56±0.46 C_1 $a_2a_3c_2$	80.74±0.65 B_1 $a_1a_2a_4a_5a_6$	85.12±0.56 $a_4c_2c_3$	83.56±0.54 $a_5b_1c_3$	85.85±00.50 C_2 $a_3a_6b_1c_1$

Note: $P < 0.001$ – a_1-a_1….a_n- a_n; $P < 0.01$ – b_1-b_1….b_n- b_n; $P < 0.05$ – c_1-c_1….c_n- c_n between genotypes within a row $P < 0.001$ – A_1-A_1….A_n- A_n; $P < 0.001$ – B_1-B_1….B_n- B_n; $P < 0.01$ – C_1-C_1….C_n- C_n between experiment I and II for the same genotype

Conclusions

Pullets from the Tetra Super Harco hybrid exhibited the earliest age at first egg compared to all other genotypes, the highest egg production, the best feed conversion per egg, the highest egg mass production, followed by the two lines of the National Gene Pool G and E. Bielefelder pullets were distinguished with the lowest egg production but also with the lowest daily feed consumption.

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