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EFFECT OF OUTDOOR ACCESS AND INCREASED AMOUNTS OF LOCAL FEED MATERIALS IN THE DIETS OF HENS COVERED BY THE GENE-POOL PROTECTION PROGRAMME FOR FARM ANIMALS IN POLAND ON QUALITY OF EGGS DURING PEAK EGG PRODUCTION*

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Abstract

The objective of the study was to test the hypothesis that eggs from native breed laying hens fed a diet containing increased amounts of local feed materials are not inferior in quality to eggs from laying hens receiving a standard diet but raised without outdoor access. The study involved Greenleg Partridge (Z-11) and Rhode Island Red hens (R-11). Within each breed, the control group (C) consisted of 60 hens kept on litter without outdoor access, stocked at 5 birds/m^2 and fed a diet containing 65.3% of local feed materials. The experimental group (E) contained 60 layers maintained on litter with access to an outdoor area (11 m^2 per bird) and fed a diet containing 77.1% of local feed materials. Eggs from hens of both breeds, which received diets containing increased proportions of local feed materials had lower weight but higher yolk percentage. The quality of eggshells from hens fed the diet with increased amounts of local materials was similar to that of eggshells from confined hens. Egg yolk lipids from experimental groups were characterized by a more beneficial *n-6/n-3* acid ratio and elevated vitamin A levels. These eggs had better sensory scores for colour, flavour and aroma, which suggests that it is appropriate to raise native breeds of chickens with outdoor access and local feed materials can be used in extensive husbandry systems.

Key words: protected breeds/lines, egg quality, outdoor system, nutrition

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Recent years have seen a growing interest in eggs from extensive husbandry. Native and local breeds are recommended for extensive husbandry systems because high-producing layer hybrids, which were developed as a result of long-term breeding work for the needs of intensive production under controlled environment conditions, are not suitable for raising under harsh free-range conditions. In Poland, native breeds have been raised in single flocks of about 1000 birds, on litter without outdoor access. In line with the European Union policy for sustainable development in agriculture, efforts are being made to reintroduce them into extensive free-range systems, in their natural environments. Although native breeds, such as Greenleg Partridge (Z-11) and Rhode Island Red hens (R-11) are characterized by lower egg production, they are less demanding in terms of the environmental conditions and are willing to use outdoor runs (Sarter, 2004; Krawczyk et al., 2011).

It appears that when promoting activities aimed at sustainable development of rural areas, it is necessary not only to promote the extensive husbandry methods and the use of native breed hens, but also to consider the possible use of local raw materials for feeds. With relatively low prices for local grains, rapeseed expeller cake and dried distillers grains with solubles, egg production in the extensive farming system could be a means of using local feed materials, putting the local grain surplus to use, and limiting the amounts of imported soybean or sunflower meal in feed mixtures. To meet the expectations of consumers, research should be undertaken to determine the effect of increased amounts of local feed materials in feeding native breed laying hens and the free-range system on egg quality.

The objective of the study was to test the hypothesis that eggs from Greenleg Partridge (Z-11) and Rhode Island Red hens (R-11) native breed laying hens fed a diet containing increased amounts of local feed materials are not inferior in quality to eggs from laying hens receiving a standard diet but raised without outdoor access.

Material and methods

The study involved Greenleg Partridge (Z-11) and Rhode Island Red hens (R-11). Until 18 weeks of age, hens of both breeds were kept on litter under standard environmental conditions and fed a standard rearing diet for hens. At 18 weeks, 60 hens of each breed were assigned to the control group (C) and 60 hens to the experimental group (E). The control group was kept on litter without outdoor access, stocked at 5 birds/m^2 and fed a standard layer diet. Within each breed, the experimental group (E) consisted of layers maintained on litter with access to an outdoor area (11 m^2 per bird) and fed a diet containing increased amounts of local feed materials (Table 1). The diet for hens from experimental groups contained 77.1% of local feed materials (ground wheat and maize, DDGS, rapeseed meal and rapeseed oil), while the diet for control layers contained only 65.27% of local feed materials (ground wheat and maize). Unlike the diet for layers from the experimental group, the diet fed to control hens of both breeds was supplemented with feed pigments to improve yolk colour intensity (Table 1). The basic chemical composition of the diets and the total protein content of egg white were analysed based on AOAC procedures (1997).

Table 1. Composition, nutritional value and major fatty acids of diets

Item	Diet/Group	
	control (C)	experimental (E)
Content (%)		
Wheat	50.27	43.10
Maize	15.00	21.00
DDGS	-	7.00
Sunflower meal	12.00	-
Soybean meal (47% CP)	9.20	12.00
Rapeseed cake	-	5.00
Rapeseed oil	-	1.00
Soybean oil	1.00	-
Wheat gluten	2.07	-
Limestone	9.00	8.80
Dicalcium phosphate	0.70	1.10
NaCl	0.22	0.3
DL-Met (99%)	0.02	0.09
L-Lys (65%)	0.01	0.11
Vitamin-mineral premix[1]	0.50	0.50
Feed pigment	0.1	-
Chemical composition		
Metabolizable energy (MJ/kg)	10.9	11.3
Crude protein (g)	167.8	160.0
Lys (g)	7.20	7.30
Met (g)	3.20	3.30
Ca (g)	37.0	36.1
Total P (g)	5.29	3.50
Vitamin A IU/kg	8775	709.1
Vitamin E (mg/kg)	35	13.9
Fatty acids (g/100 g)		
C12:0	0.02	0.06
C16:0	14.69	13.16
C16:1	0.18	0.19
C18:0	2.55	2.16
C18:1	24.49	34.24
C18:2, *n-6*	50.38	43.82
C18:3, *n-3*	4.85	5.25
C20:0	0.73	0.38
C22:1	0.38	0.19
other	1.72	0.65
SFA	17.99	15.76
UFA	80.29	83.59
MUFA	25.05	34.61
PUFA, *n-6*	50.38	43.85
PUFA, *n-3*	5.02	5.29
n-6/n-3	10.04	8.29

[1]The premix provided, per 1 kg of diet: vitamin A – 8.000 IU; vitamin D_3 – 3.000 IU; vitamin E – 40 IU; vitamin K_3 – 2 mg; vitamin B_1 – 1 mg; vitamin B_2 – 4 mg; vitamin B_6 – 1.5 mg; vitamin B_{12} – 0.01 mg; Ca--pantothenate – 8 mg; niacin – 25 mg; folic acid – 0.5 mg; choline chloride – 250 mg; manganese – 90 mg; zinc – 90 mg; iron – 50 mg; copper – 12 mg; iodine – 1.2 mg; selenium – 0.2 mg.

During the entire egg production period, both control and experimental hens received a photoperiod of 16L:8D. During the period preceding the collection of eggs for analysis, the mean air temperature was 16±2ºC indoors and ranged from 22±5ºC (August) to 11±6ºC (November) in the outdoor area.

Tests were conducted with 184 eggs (46 eggs from each group) collected from layers during peak egg production (33 weeks of age, third week of November). Thirty eggs from each group were evaluated for physical characteristics of egg shells and interior egg. Shell strength was determined using a texture analyser (Stable Micro Systems Ltd., England). Egg quality traits, i.e. egg weight, shell colour, density and thickness, yolk weight, albumen height, Haugh units and Roche yolk colour were measured with EQM system (TSS Ltd., England).

The content of higher fatty acids in feeds and egg yolks (8 eggs from each group – 2 eggs per sample) was analysed with gas chromatography by determining the acids as methyl esters. Samples were prepared according to the procedure of the Central Laboratory of the National Research Institute of Animal Production, based on a method described by Folch et al. (1957) involving homogenization of the sample in a mixture of chloroform and methanol (2/1) and solvent evaporation, followed by saponification (0.5 N NaOH in methanol) and esterification (BF_3 in methanol) of the evaporation residue. The fatty acid methyl esters obtained were determined in hexane extracts by gas chromatography (VARIAN 3400) using a column filled with acid-modified polyethylene glycol (e.g. ZEBRON ZB-WAX 30m), an 8200 CX autosampler and data processing software.

Analyses of egg yolk (8 eggs from each group – 2 eggs per sample) for vitamin A and E content were performed according to an accredited procedure based on standards PN-EN ISO 14565 (all-trans-retinol, vitamin A) and PN-EN ISO 6867 (α-tocopherol, vitamin E).

Boiled eggs were subjected to sensory analysis (yolk colour, aroma and flavour). Each trait was assessed on a scale of 1 (lowest) to 5 (highest).

The results were subjected to two-way analysis of variance with Duncan's multiple range test using Statgraphics 5.0 Plus.

Results

The study showed no effect of outdoor access and increased amounts of local feed materials on eggshell shape or colour ($P>0.05$) (Table 2).

Chickens of both breeds raised with outdoor access laid eggs with 0.30 g lower shell weight ($P<0.01$). Shell density, thickness and strength were similar for experimental and control groups of both breeds ($P>0.05$) (Table 2).

In the present study, chickens of both breeds that had access to free range produced lighter eggs ($P<0.01$) (Table 3). The decrease in egg weight under free-range system (E) was not paralleled by a decrease in yolk weight, which caused free-range eggs to have higher yolk and lower albumen percentage ($P<0.01$).

Eggs from the experimental groups of both breeds were characterized by lower albumen height (P<0.01) and lower Haugh units (P<0.05) (Table 3).

Table 2. Effect of hen breed and diet on egg shape index and shell quality

Group	Shape index (%)	Shell				
		colour (%)	weight (g)	density (mg/cm^2)	thickness (μm)	strength (N)
Breed/group						
R-11 C	75.9	44.6	5.77	78.6	343	51.2
R-11 E	76.7	44.9	5.39	75.9	339	48.5
Z-11 C	76.4	61.2	5.32	76.9	343	50.3
Z-11 E	74.8	60.7	5.09	76.4	334	47.1
Breed						
Z-11	75.6	60.9	5.21	76.7	339	48.7
R-11	76.3	44.8	5.58	77.2	341	49.8
Diet						
C	76.2	52.9	5.54	77.7	343	50.8
E	75.8	52.8	5.24	76.2	337	47.8
Breed	NS	**	**	NS	NS	NS
Diet	NS	NS	**	NS	NS	NS
B×D	*	NS	NS	NS	NS	NS
SEM (N = 120)	2.66	9.11	0.558	7.90	30.0	10.7

NS – not significant; * – P≤0.05; ** – P≤0.01.

Yolk colour intensity was smaller for eggs from Z-11 and R-11 hens receiving the diet without feed pigments and with outdoor access compared to eggs from hens fed the standard layer diet supplemented with pigments (P<0.01).

The yolk of eggs from the control and experimental groups in each breed had similar levels of vitamin A (P>0.05). The yolks of eggs from experimental layers of both breeds had a significantly lower content of vitamin E (P<0.01).

The percentage of different fatty acids in yolk lipids of eggs from Z-11 and R-11 hens kept with (E) and without outdoor access (C) is given in Table 4. The present study showed that the diets had an effect on the fatty acid profile. Changes in the content of different fatty acids were observed for SFA, UFA, MUFA, both PUFA series and the *n-6/n-3* ratio. Feeding layers a diet with an increased proportion of local materials while allowing outdoor access contributed to a decrease in total polyunsaturated fatty acids (PUFA) in yolk fat, including *n-6* acids, and to an increase in the proportion of monounsaturated fatty acids (MUFA) and *n-3* acids, especially docosahexaenoic acid (DHA; C22:6) in yolk fat (P≤0.01). The analysed yolks were found to contain trace amounts of eicosapentaenoic acid (EPA; C20:5).

In the sensory evaluation of boiled eggs (Table 5), more points for yolk colour intensity, odour and flavour were given to eggs from experimental layers (P<0.01).

Table 3. Effect of hen breed and diet on interior egg quality

Group	Egg weight (g)	Albumen height (mm)	Haugh units	Yolk colour (Roche)	Yolk weight (g)	Content in egg (%):			Protein (%)	Vit. A (mcg/g)	Vit. E (mcg/g)
						yolk	albumen	shell			
Breed/group											
R-11 C	55.1	7.85	89.5	6.73	14.7	26.6	62.9	10.5	12.07	3.41	123.0
R-11 E	51.3	7.59	88.4	4.26	14.4	28.0	61.4	10.5	11.58	3.47	38.1
Z-11 C	50.4	6.75	84.4	6.16	13.5	26.8	62.6	10.6	11.39	3.97	130.8
Z-11 E	49.3	5.82	78.9	4.86	13.7	27.9	61.7	10.3	11.38	3.95	52.7
Breed											
Z-11	49.8	6.29	81.7	5.51	13.6	27.4	62.1	10.4	11.38	3.96	80.6
R-11	53.2	7.72	88.9	5.49	14.5	27.3	62.1	10.5	11.83	3.44	91.7
Diet											
C	52.7	7.30	86.9	6.45	14.1	26.7	62.7	10.5	11.73	3.69	126.9
E	50.3	6.71	83.7	4.56	14.1	27.9	61.6	10.4	11.48	3.71	45.4
Breed	**	**	**	NS	**	NS	NS	NS	*	*	NS
Diet	**	**	*	**	NS	**	**	NS	NS	NS	**
B×D	*	NS	NS	*	NS	NS	NS	NS	NS	NS	NS
SEM (N = 120)	3.76	1.49	8.53	1.63	1.28	7.90	30.0	10.7	0.562	0.537	47.4

NS – not significant; * – $P \leq 0.05$; ** – $P \leq 0.01$.

Table 4. Effect of genotype and diet on major fatty acids (% of total FA) content in yolk lipids

Fatty acid (x±SD)	Breed		Diet		Breed	Diet	Breed × diet	SEM (N = 64)
	R-11	Z-11	C	E				
C12:0	0.029±0.01	0.037±0.01	0.025±0.009	0.04±0.02	NS	**	NS	0.00
C14:0	0.64±0.16	0.63±0.14	0.55±0.05	0.73±0.16	NS	**	NS	0.03
C16:0	31.3±1.68	31.4±0.82	31.1±1.1	31.6±1.47	NS	NS	NS	0.23
C16:1	4.02±0.59	4.07±0.44	4.08±0.34	4.01±0.65	NS	NS	NS	0.09
C18:0	8.12±0.79	7.95±0.61	7.64±0.28	8.43±0.78	NS	*	NS	0.12
C18:1	42.35±2.74	40.7±2.32	39.9±1.97	43.1±2.23	*	**	NS	0.47
C18:2, *n-6*	9.54 ±2.9	11.15±2.37	12.7±0.88	7.95±1.54	**	**	NS	0.48
C18:3, gamma	0.10±0.009	0.10±0.03	0.11±0.018	0.09±0.014	NS	*	*	0.00
C18:3, ALA, *n-3*	0.48±0.11	0.67±0.09	0.58±0.08	0.58±0.17	**	NS	*	0.02
C20:4	1.75±0.14	1.87±0.22	1.88±0.18	1.73±0.17	*	**	*	0.03
C20:5, EPA, *n-3*	traces	traces	traces	traces	-	-	-	-
C22:6, DHA, *n-3*	0.86±0.15	0.89±0.28	0.75±0.13	1.00±0.23	NS	**	**	0.04
other	0.5±0.09	0.47±0.08	0.43±0.05	0.54±0.08	NS	**	NS	0.02
SFA	40.17±2.15	40.07±1.10	39.38±1.00	40.86±1.91	NS	**	*	0.30
UFA	59.24±2.13	59.38±1.08	60.1±0.97	58.53±1.85	NS	**	*	0.30
MUFA	46.38±2.46	44.81±2.06	44.03±1.7	47.16±1.87	*	**	NS	0.42
PUFA, *n-6*	11.5±3.1	13.0±2.35	14.7±0.79	9.78±1.61	**	**	*	0.50
PUFA, *n-3*	1.35±0.23	1.57±0.34	1.32±0.09	1.59±0.39	**	**	**	0.05
n-6/n-3	8.45±2.3	8.87±3.09	11.15±0.92	6.18±0.97	NS	*	*	0.48
desaturase index[1]								
C16:1/ (C16:0+C16:1)	0.11±0.00	0.11±0.00	0.11±0.01	0.12±0.00	NS	NS	NS	0.001
C18:1/(C18:0+C18:1)	0.84±0.01	0.84±0.01	0.84±0.02	0.84±0.00	NS	NS	NS	0.002
AI[2]	16.15±2.85	17.87±1.89	18.99±0.95	15.02±1.99	**	**	*	0.44

[1, 2]Atherogenicity index (C12:0 + 4 × C14:0 + C16:0) / (MUFA + PUFA); NS – not significant; * – P≤0.05; ** – P≤0.01.

Table 5. Effect of hen breed and diet on sensory scores on a scale of 0 to 5 points

Group	Yolk colour	Egg odour	Egg flavour
Breed/group			
R-11 C	3.15	3.43	3.42
R-11 E	4.08	3.89	3.89
Z-11 C	3.10	3.70	3.42
Z-11 E	4.26	3.98	4.06
Breed			
Z-11	3.68	3.84	3.74
R-11	3.62	3.61	3.66
Diet			
C	3.13	3.52	3.42
E	4.17	3.93	3.98
Breed	NS	*	NS
Diet	**	**	**
B×D	NS	NS	NS
SEM (N = 192)	0.835	0.802	0.755

NS – not significant; * – P≤0.05; ** – P≤0.01.

Discussion

The present study showed that feeding layers a diet with increased amounts of local feed materials, together with outdoor access, results in eggs with good quality traits.

In accordance with the gene-pool protection programme for farm animals in Poland, no selection is practiced in the flocks of Greenleg Partridge (Z-11) and Rhode Island Red hens (R-11), which results not only in low productivity of laying hens, but also in low egg weight, as confirmed by the present and other studies (Krawczyk, 2009).

The similar egg shape and shell colour in the control and experimental groups of both breeds supports the argument that these traits are influenced by genetic factors and layer age (Odaba et al., 2007; Tumová et al., 2007) rather than housing system and nutrition.

Although many studies indicate that outdoor access has an effect on shell quality, the widely varying results preclude making clear and definite conclusions on the relationship between housing system and shell quality. In a study by Hidalgo et al. (2008) shell thickness was lowest for eggs from caged hens and showed more variation in the litter and free-range systems. Meanwhile, Pavlovski et al. (2001) reported that free-range eggs had thinner shells compared to eggs from litter housing. Hidalgo et al. (2008) demonstrated no differences in shell strength between eggs from different housing systems. In our study, shell quality traits of eggs from experimental hens did not deteriorate despite a slightly lower weight, which possibly indicates that outdoor areas were rich in minerals that build the eggshell. In the previous studies use of hen's diets containing DDGS and rapeseed expeller cake had also no effect on eggshell quality (Świątkiewicz and Koreleski, 2006; Świątkiewicz et al., 2010; Koreleski et al., 2011).

Compared to eggs from control hens of both breeds, eggs from experimental hens had lower total weight (by 2.4 g) but similar yolk weight, as a result of which egg yolk percentage was higher in the experimental groups. Likewise, Simčič et al. (2009) demonstrated that yolk weight of eggs from native breed hens kept under free-range conditions was higher than that of eggs from caged hens. Lower egg weight and higher yolk percentage in native breed hens, compared to commercial hens, were reported by Rizzi and Chiericato (2005) in Robustamaculata and Ermellinata di Rovigo hens, and by Simčič et al. (2009) in Styrian hens. Other than hen's genotype, egg weight is influenced by the nutritive value of diet, in particular protein percentage (Keshavarz and Nakjima, 1995). Perhaps the slightly lower protein content of the feed given to experimental hens and the lower mineral levels in the free-range areas during collection of eggs for analysis (November) prevented the hens from supplementing their diets with nutrients from the free-range areas and caused a decrease in egg weight in this group, as also shown by similar results of Sekeroglu et al. (2008).

The slightly lower values of Haugh unit and albumen height obtained in our study for eggs from experimental hens of both breeds fall within normal limits, are similar to the results obtained by other authors (Cywa-Benko, 2002; Krawczyk, 2009), and give no indication of decreased sensory quality of eggs.

Yolk colour intensity depends mainly on the xanthophyll and carotene content of the hen's diet. Because the feed given in our study to experimental chickens contained no additional pigments, it can be assumed that the yolk colour of eggs from experimental hens (4.26 and 4.86 points according to Roche colour fan) is evidence that allowing birds access to the free range ensures satisfactory yolk colour. As results from the studies by Zielińska (1965) and Hughes et al. (1985), layers having access to the free range consume about 20–35 g more dry matter in the form of grasses and herbs. Green forage consumed by layers on the free range has a beneficial effect on yolk colour intensity (Sekeroglu et al., 2008), which is also confirmed by our study. The experimental diet contained also corn DDGS that is a good source of available carotenoids and often had beneficial effect on yolk colour intensity (Świątkiewicz and Koreleski, 2008).

In the yolks of eggs from layers allowed outdoor access, the vitamin A content was similar to eggs from layers housed indoors. Our study failed to show the linear relationship reported by Mendonça et al. (2002) between vitamin A content of feed and eggs, but we found this relationship to occur for vitamin E, similar to the study of Bölükbaşi et al. (2007). Although the feed given to hens in the experimental group contained 10 times less vitamin A compared to the feed given to control layers, the vitamin A content of yolks in eggs from experimental groups remained similar to that found in the control group, which leads us to suggest that hens with outdoor access had an additional source of vitamin A in carotene-rich plants consumed on free range. Hens of the analysed breeds like to feed on free range (Sokołowicz and Krawczyk, 2007). Part of β-carotene in the hen's body is transformed into vitamin A (Hencken, 1992), which may account for its increased proportion in egg yolks. Perhaps also the availability of plant β-carotene is higher compared to synthetic vitamin found in feed.

Our study found that increased retinol content of yolk is paralleled by a decreased concentration of tocopherol. Also Mendonca et al. (2002) observed that tocopherol concentration decreased with increasing retinol content of yolk, which they believe shows an antagonism between these vitamins.

The high yolk percentage in the weight of all analysed eggs, which in our study increased by an extra 1.2% in the experimental groups, is characteristic of protected breed hens, as confirmed by Krawczyk (2009).

The fatty acid profile of the diet fed to laying hens has an effect on the fatty acid profile of egg yolk fat. Baucells et al. (2000) report that with regard to *n-3* fatty acids, 85% of EPA and 78% of DHA content of egg can be due to the presence of these acids in the hen diet. Studies by Leskanich and Noble (1997) and Meluzzi et al. (1997) suggest that part of DHA in yolk fat comes directly from the diet and part from the conversion and *de novo* synthesis of precursor acids, namely α-linolenic (ALA), eicosapentaenoic (EPA) and docosapentaenoic (DPA). α-linolenic acid, the precursor of *n-3* acids, is converted by the enzymes Δ-6 desaturase and elongase to *n-3* PUFA, i.e. EPA and DHA. The same combination of enzymes is used to convert linoleic acid (C18:2), the precursor of *n-6* acids, to arachidonic acid (C20:4). The level of long-chain fatty acids in products of animal origin, including egg yolk fat, is dependent on the ratio of *n-6* and *n-3* precursors in the diet given to animals.

Being an integral part of feeding layers under free-range conditions, green forage is a source of relatively large amounts of *n-3* fatty acids as well as α-tocopherols and various fat-insoluble substances, which may be important from the standpoint of human nutrition (Lynch, 1991; Tramontano et al., 1993). The high level of linoleic (LA; C18:2) and linolenic acids (ALA; C18:3) in laying hen diets affects the profile of fatty acids regardless of the breed/line, just like forage consumed by the birds. It can be presumed that the higher content of C18:3 in Z-11 hens could result from the higher intake of free-range forage, because according to Sokołowicz and Krawczyk (2007) the Z-11 breed is particularly eager to feed on free range.

Egg flavour and odour reflect the chemical composition, in particular the proportion of amino acids and lipids (Cherian et al., 2002). Consumers feel that it is the flavour of free-range eggs that makes them attractive (Sokołowicz et al., 2008). In our study, eggs from layers raised with outdoor access had higher scores for flavour and odour compared to eggs from confined hens. Likewise, Horsted et al. (2010) concluded that under the free-range system, the presence of forage in layer nutrition is an important factor that improves egg colour and flavour. The effect of diet, genotype and environment on fatty acid profile and sensory properties of eggs was also reported by Rizzi and Marangon (2012).

In conclusion, eggs from hens of both breeds, which received diets containing increased proportions of local feed materials without pigments, had lower total weight but higher yolk percentage. The quality of eggshells from hens fed the diet with increased amounts of local materials was similar to that of eggshells from confined hens. Egg yolk fat from experimental groups was characterized by a more beneficial *n-6/n-3* acid ratio and elevated vitamin A levels. These eggs had better sensory scores for all traits evaluated, which suggests that it is appropriate to raise native breeds of chickens with outdoor access and local feed materials can be used in extensive husbandry systems.

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Wpływ dostępu do wybiegu i zwiększonego udziału krajowych komponentów paszowych w żywieniu rodów kur objętych programem ochrony na jakość jaj w szczycie nieśności

STRESZCZENIE

Celem przeprowadzonych badań było zweryfikowanie hipotezy zakładającej, że jaja pochodzące od niosek kur ras rodzimych żywionych paszą zawierającą zwiększony udział lokalnych komponentów paszowych nie ustępują pod względem jakości jajom od niosek żywionych standardową mieszanką paszową, ale utrzymywanych bez dostępu do wybiegu. Badaniami objęto kury ras zielononóżka kuropatwiana (Z-11) i Rhode Island Red (R-11). Grupę kontrolną (C) w obrębie każdej rasy stanowiło 60 kur utrzymywanych na ściółce, bez dostępu do wybiegu przy obsadzie 5 szt/m^2 i żywionych paszą zawierającą 65,27% krajowych komponentów paszowych. Grupę doświadczalną (E) stanowiło 60 niosek utrzymywanych na ściółce ze swobodnym dostępem do wybiegu o powierzchni 11 m^2 na kurę i żywionych mieszanką zawierającą 77,1% krajowych komponentów paszowych. Jaja od kur obydwu ras żywionych paszą o zwiększonym udziale lokalnych krajowych komponentów paszowych, bez dodatku barwników, charakteryzowały się mniejszą masą całkowitą, ale większym procentowym udziałem

żółtka. Jakość skorupy jaj od kur żywionych paszą o zwiększonym udziale komponentów krajowych była podobna do skorupy z chowu bezwybiegowego. Żółtka jaj z grup doświadczalnych charakteryzowały się korzystniejszym stosunkiem kwasów *n-6/n-3* oraz podwyższonym poziomem witaminy A. Jaja te uzyskały lepsze wyniki w ocenie sensorycznej w zakresie barwy, smaku i zapachu, co wskazuje na zasadność wybiegowego systemu chowu kur ras rodzimych i możliwość zagospodarowania krajowych komponentów paszowych w ekstensywnym chowie kur.