Scientific Annals of Polish Society of Animal Production - Vol. 9 (2013), No 2, 23-31

The effect of rearing system on performance and slaughter value of slow-growing Hubbard JA 957 chickens

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The aim of the study was to determine production results and usefulness of slow-growing Hubbard JA 957 chickens for free range system. 935 slow growing Hubbard JA 957 chickens were divided into two groups: the control group (K) without outdoor access and experimental group (E) with outdoor access from 4 week of life. The extended rearing to 63 day of life and access to open air did not affect significantly performance and slaughter value of JA 957 chickens. The significant (P≤0.01) increase in the volume of heart muscle (myocardium) was observed in the group of birds, utilizing the outdoor.

KEY WORDS: slow growing chickens / free ranging / production results / slaughter value

In rearing meat poultry productivity depends on genetic and environmental factors. In nucleus flocks of meat chickens performance traits may be improved through breeding. Selection is focused on such traits as growth rate, feed conversion rate and health. Among environmental factors nutrition is of greatest importance, since it is estimated that feeding costs account for approx. 65-70% all expenses incurred in the production of slaughter chickens. For producers, apart from the situation on the meat market, the most important index determining profitability of animal rearing is connected with the relationship between the amount of consumed feed and produced live weight, i.e. feed conversion rate (FCR).

At present production of poultry meat in Poland is based on slaughter chicken hybrids highly selected towards meat production traits and kept in the intensive production system. Over the last 30 years slaughter weight of broiler chickens has increased 2-fold, while the length of the rearing period was reduced by almost 50% [9]. The rapid increase in body weight in these birds, at the disturbed equilibrium in the development of the entire organism, frequently leads to many disorders, such as e.g. the sudden death syndrome, ascites,

breast blisters, limb disorders such as femoral head necrosis or tibial dyschondroplasia [28]. These disorders have a negative effect not only on chicken health, but they also cause a major deterioration of meat quality. A serious problem is connected with the impaired capacity to produce antibodies and the resulting increased susceptibility to disease. In the intensive production system birds may not express their natural behaviours, which as a consequence leads to a dramatic deterioration of their welfare. In the Galliformes such natural behaviours include e.g. locomotion activity, scratching, pecking, foraging, wing flapping, preening as well as sun and sand bathing. Limited opportunity to express such behaviour in birds may result in disorders leading to mutual pecking and mutilation [13]. Chickens kept in alternative management systems have access to greater living space and may manifest their innate behaviour more freely. On the other hand, birds kept on the run in the outdoor rearing system are exposed to a greater risk of bacterial and viral infections in comparison to those kept on the litter in a windowless poultry house.

Animal welfare is a major factor influencing conscious consumer purchase decisions [20]. Recent studies have shown that almost 50% surveyed British consumers considered animal welfare to be a "very important" factor [10], while 76% [5] and 85% [4] considered it to be "important", having an indirect effect on the technological suitability and shelf--life of food, particularly from their point of view of its wholesomeness and safety. Over 70% surveyed Americans expressed their "concern" for the welfare of farm animals [23]. Consumers of poultry meat are increasingly more interested in animal welfare as well as the quality and safety of animal-origin products [6]. Many consumers are concerned with animal management conditions and the adopted rearing system. At present also Polish consumers increasingly often consider buying chicken meat reared in less intensive animal production systems, with access to outdoor runs, being of an opinion that such meat is superior in quality.

In Poland the most common management system for slaughter chickens is the intensive production system, while the free-range system is adopted as an alternative system. This provides an opportunity to increase efforts to care for the natural environment, preserve biological diversity as well as popularise eco-friendly production methods. In the opinion of many consumers strict standards concerning welfare of slaughter chickens ensure high quality of their products [2, 27, 29]. Conventional indoor animal management systems cause stress in chickens [12] and as a consequence they induce various physiological and behavioral responses [16] and result in the deterioration of productivity [17]. In the case of these birds reduced stress, increased comfort and improved animal welfare cause a definite improvement of taste and aroma of the resulting products in comparison to those obtained in conventional production systems [8, 14]. In the opinion of Lichovnikova et al. [15], free--range rearing provides an opportunity to use cockerel chicks rejected in the sexing process and to obtain their meat with comparable or even better quality attributes in comparison to fast-growing breeds (meat of these cockerels contains more protein and less fat).

The aim of the presented study was to compare productivity and slaughter value of Hubbard JA 957 chickens kept in two management variants: with and without access to outdoor runs.

Material and methods

The experiment was conducted on the RZD Wilanów Obory experimental farm of the Warsaw University of Life Sciences – SGGW from July to September 2010 (Table 1).

Table 1
Weather station data (division in Warsaw) for the year 2010

Month	Temperature (°C)	Humidity (%)
July	18.1	85.7
August	18.9	74.4
September	15.1	76.5

All the experimental procedures met the requirements specified by the Ethics Committee in their decision no. 27/2009 (of 16 April 2009). Analyses were conducted on 935 Hubbard JA 957 chickens kept on litter until day 63 of life under typical management conditions in a housing facility with no access to daylight. Sexing was performed following the Japanese method, with birds marked with chicken tags. One-day old chicks were allocated at random to 2 groups with 5 replications each: K (the control) and E (experimental). The differentiating factor was connected with access to an outdoor run starting from week 4 of life in the experimental group. In the rearing period a three-stage feeding regime was adopted: based on starter mixes (crumbles), grower and finisher feeds (granulate) – Table 2. Birds were fed at libitum.

No coccidiostats were added to the used feed mix, since the chicks were vaccinated against coccidiosis at day 1 of life. Stocking in the poultry house in both groups amounted to 11 birds per 1 m^2 floor area; additionally, chickens from the experimental group had access to a grassy run of 3x5 m for 12 hours a day. Chickens using runs had access to green forage, composed of the following grasses: perennial ryegrass (40%), red fescue (50%) and smooth meadow grass (10%), respectively. The run provided the birds with the potential to express their basic instincts such as scratching or sand bathing. The run was dry, with well-drained soil and considerable insolation. It was protected against access of rodents, poaching and feral animals (martens, cats, dogs) and wild fowl. Moreover, half of the run area was roofed. The following parameters were monitored in the course of the experiment: body weight of chickens at days 1, 12, 24, 42 and 63 of rearing, feed intake as well as falls and culling.

At the end of the rearing period at day 63 from each experimental group a total of 24 cockerels and 24 hens were selected, with their body weight close to the mean for a given sex in the group. Chicken carcasses were cooled by air chilling at 4°C for 24 h, next they were dissected, on the basis of which their slaughter value was determined and the share of breast muscles, legs, abdominal fat and gizzards in the carcass was calculated.

Table 2
Composition (%) and nutritive value of mixtures

Specification	Starter (1-24)	Grower (25-42)	Finisher (43-63)
Maize	10.00	10.00	10.00
Wheat	49.56	53.76	60.26
Wheat middlings	5.00	7.00	8.00
Sunflower meal	4.70	7.00	8.00
Soybean meal	25.30	17.10	9.30
Limestone	1.00	1.10	0.87
Sodium bicarbonate	0.24	0.24	0.25
NaCl	0.24	0.21	0.22
Dicalcium phosphate	1.31	0.96	0.74
Soybean oil	1.30	1.30	1.30
Methionine	0.32	0.28	0.19
Lysine	0.36	0.38	0.28
Threonine	0.12	0.12	0.04
Premiks – Rovimix DSM	0.55	0.55	0.55
Nutritional value			
metabolizable energy (kcal)	2849.54	2857.57	2901.85
fat	3.00	3.03	3.04
crude protein	21.68	19.50	16.98
fibre	3.60	3.96	4.07
ash	5.85	5.40	4.69
lysine	1.30	1.13	0.87
met+cys	0.97	0.89	0.76
calcium	1.06	0.99	0.82
available P	0.48	0.42	0.38

Recorded results were analysed statistically using the analysis of variance, applying the least squares method in the SPSS 19.0 PL statistical software (SPSS Inc., Chicago, IL, USA).

Results and discussion

Data on falls and culling of birds during the 9-week rearing period is presented in Table 3. The conducted statistical analysis showed no significant differences in the mortality levels.

Table 3
Mortality and culling (%) over 9 weeks' period of rearing

Group	Mortality	Culling	Total
K	1.1	3.7	4.7
E	1.5	2.4	3.9

A greater number of culled chickens was recorded in the control, i.e. the group having no outdoor access. Slow-growing chickens are characterised by better health and lower mortality, which is confirmed by a study of Mikulski et al. [18]. In chickens reared with access to a run mortality rate was 3.9%, while in chickens having no outdoor access it was 4.7%.

Based on the dissection results of dead birds and examination of culled chickens it was established that up to day 10 of life their falls and culling were caused by inflammations of the navel and gall bladder (omphalitis and cholecystitis). Between weeks 2 and 9 the most common disorders included pulmonary hyperemia, exudative diathesis and the sudden death syndrome. Culled birds had leg deformations, torticollis and obstruction of the crop.

From the point of view of producers the Feed Conversion Ratio (FCR) in a broiler chicken flock is the fastest method to estimate profitability of rearing. Rearing conditions (access to a run) had no effect on feed consumption indexes in JA 957 chickens. In typical broiler chickens flocks, in which rearing is completed at the age of 6 weeks, FCR does not exceed 2 kg/kg body weight gain [3, 11, 21, 26]. According to the rearing recommendations for Hubbard JA 957 flocks, this value is 2.27 kg/kg during the 63-day rearing. In this study slightly higher values were recorded: 2.33 kg/kg in the K group and 2.32 kg/kg in the E group (Table 4). Similar FCR values were reported by Castellini et al. [2], Nielsen et al. [22] and Fanatico et al. [7]. In slow-growing chickens a higher feed conversion ratio is acceptable [19, 30].

Due to the slower growth rate of females in comparison to males, resulting from physiological differences, body weight needs to be characterised by each sex separately. Table 5 presents body weight of birds in the control (K) and the experimental group (E) at successive days of rearing, while Table 6 gives slaughter performance data.

No effect was observed of rearing conditions (access to a run) on the final body weight of chickens. At day 63 of rearing body weight of cockerels was on average 3.4 kg, while

Table 4
FCR values in subsequent periods of rearing JA 957 chickens

Day of rearing	FCR (kg/kg)	
	group K	group E
1 – 12	1.18	1.16
1 – 24	1.54	1.54
1 – 42	1.88	1.87
1 – 63	2.33	2.32

Table 5
Body weight (g) of slow growing JA 957 chickens

Sex	Day of rearing	Group K		Group E	
		LSM	SE	LSM	SE
♂♂	1	38.2	0.26	38.5	0.22
	12	312.9	1.75	315.0	1.44
	24	783.7	4.53	791.1	5.51
	42	2031.1	10.88	2020.6	13.25
	63	3487.2	20.76	3494.0	17.05
♀♀	1	40.9	0.25	40.8	0.22
	12	286.8	2.38	285.6	2.09
	24	724.2	5.44	722.1	4.79
	42	1630.4	10.14	1620.2	8.93
	63	2692.4	14.81	2798.9	16.82

in hens it was 2.7 kg (Table 5). It was observed that chickens having outdoor access were characterised by a slightly greater body weight at the end of the rearing period; however, the differences were statistically non-significant.

Rearing conditions (access to runs) had no effect on the yield of breast muscles and legs in 63-day chickens (Table 6). Similar results were reported by Breslavets and Dyachenko [1] when assessing dressing percentage values depending on chicken rearing conditions. Literature sources show a marked diversity in slaughter value of broiler chickens. Pietrzak et al. [24], when evaluating slaughter value of 7-week old slow-growing chickens reared in the closed system reported a dressing percentage of approx. 69%. Analyses conducted by Castellini et al. [2] showed that carcasses of chickens kept with access to a run were characterised by a greater percentage share of breast muscles and drumsticks, as well as a lower fat content in the abdominal cavity, which was not confirmed in this study. In turn, Nielsen et al. [22] in slow-growing chickens found a significantly ($P \leq 0.05$) lower share of breast muscles and a greater ($P \leq 0.05$) share of thigh and tibial muscles in comparison to fast growing chickens.

Table 6
Results of slaughter analysis of JA 957 chickens

Group	Sex	Body weight (g)	Dressing percentage (%)	Breast muscles (%)	Leg muscles (%)	Gizzard (%)	Liver (%)	Heart (%)	Abdominal fat (%)
K	♂	3487.21	73.50	21.72	20.71	0.86	1.65	0.33^{B}	2.64
	♀	2692.38	73.62	23.56	19.02	0.96	1.88	0.32	3.13
E	♂	3494.04	74.18	21.59	20.67	0.80	1.66	0.37^{A}	2.54
	♀	2798.91	73.97	23.91	19.46	0.91	1.77	0.34	3.25

A, B – $P \leq 0.01$

No significant differences were observed in this study for the share of abdominal fat in carcasses – their higher amounts were recorded in hens. In the case of the share of gizzards in carcasses a significant increase ($P \leq 0.01$) was observed in the volume of the cardiac muscle in the group of cockerels having outdoor access (Table 4). Also Polak [25] reported an increase ($P \leq 0.05$) in the cardiac muscle volume in 42-day chickens kept in the extensive rearing system. In the opinion of the author, the increased myocardium volume in birds having access to a run was probably influenced by the increased cardiac function, caused by intensive mobility of chickens on the runs.

In conclusion it may be stated that slow-growing JA 957 chickens constitute valuable material for production of slaughter animals. Access to a run during the rearing period extended to day 63 of life had no significant effect on productivity or slaughter value of chickens.

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„Research was realized within the project "BIOFOOD – innovative, functional products of animal origin" no. POIG.01.01.02-014-090/09 co-financed by the European Union from the European Regional Development Fund within the Innovative Economy Operational Programme 2007 – 2013"