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The influence of the housing system on selected production features of chickens of Ross 308 parent stock

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The aim of the research was to analyse the effect of the housing system on selected reproductive traits of parent stock of Ross 308 meat chickens. The study was conducted on two flocks, one of which was kept in a chicken house on a concrete floor entirely covered with litter, and the second in a chicken house in which one-third of the floor was a plastic slatted floor and the other two-thirds was a concrete floor covered with litter. During the 38-week laying period, an average of 179.7 eggs were obtained from laying hens kept in the chicken house with a litter floor, including 168.2 hatching eggs, and 187,4 and 175.6 eggs, respectively, from hens kept in the chicken house with a slatted/litter floor (differences not statistically confirmed). The housing system non-significantly influenced feed intake and the number of eggs laid depending on where they were laid (inside or outside the nest). In the litter system, eggs outside the nest accounted for 3.1% and in litter/slatted floor system 9.8% of the total number of eggs laid; the differences were statistically non-significant.

KEY WORDS: hens / housing system / productivity

Numerous studies conducted in Poland and abroad indicate that the suitability of eggs for hatching and their biological value are determined not only by the genotype of birds, but also by environmental factors [1, 11, 17, 18, 19, 33]. According to Groen [14], Mathura [24] and Zijppa et al. [35], the genetic predisposition of laying hens for high egg-laying capacity can be manifested only under optimal environmental conditions.

Proper diet, together with other environmental factors, determines the realization of the full genetic potential of any animal species. It is a condition of good health, well-being, and high productivity, as well as the quality of the products obtained. Poultry has much higher feed quality requirements than most livestock, due to faster metabolism, higher growth rates, a shorter sexual maturation period, higher body temperature, and greater responsiveness to environmental conditions [12, 13]. In particular, the body weight of hens and cocks of parent stock largely depends on their diet. Feed rations that are too large may

cause a marked increase in the body weight of the birds, which significantly reduces the sexual activity of cocks and fertility rates. The feed rations should also not be too small, as this increases agitation and aggression in the flock, and in extreme cases even pterophagia or cannibalism [15].

According to many researchers [8, 9, 10, 22, 30, 31], reproductive traits are influenced by the housing system in which the flock is kept. The literature indicates that most studies have found that the housing system has a significant effect on laying results and rates, as well as on the health and feed consumption of the birds, but a much smaller effect on the quality of hatching eggs. The influence of the housing system on egg quality has been demonstrated by Basmacioglu and Ergul [2] and by Krawczyk [20]. Marked differences in the results and in the progression of egg laying were demonstrated between cage and litter systems [22, 31]. According to Lewko and Gornowicz [23], the housing system affects the quality of yolks in chicken eggs. It should be added that the housing system is inextricably linked to the place where hens lay their eggs. Only eggs laid in nests can be used for hatching; others should be discarded.

Hatching eggs are primarily subject to assessment of external characteristics. The most important features of eggs, determining whether they qualify for incubation, are their weight, their shape, and the structure and condition of the shell. Proper egg structure is the basic condition for obtaining satisfactory hatching results [4, 6].

Research on the effect of egg weight and shape indicators on hatchability of chicks was already being conducted in the 1980s and 1990s [3, 5]. Pijarska [26] and Reijrink et al. [28], who analysed the effect of egg weight on the weight of hatched chicks, showed that this trait had a significant effect on the hatchability of healthy chicks. Therefore, in breeding flocks it is extremely important to obtain not only a large number of eggs, but above all eggs of standard weight and shape that are suitable for hatching. Relatively few studies have been carried out on the assessment of hatching eggs and factors determining their characteristics, which prompted us to take up this topic.

The study was carried out to analyse the effect of the housing system on selected reproductive traits of parent stock of Ross 308 meat chickens.

Material and methods

The material for the study was two flocks of Ross 308 meat chickens. At the start of the study, the first flock numbered 9245 hens and 976 cocks (flock A), and the other 8660 hens and 822 cocks (flock B). The study covered the period from the 14th to the 60th week of life of the hens and the period from the 23rd to the 60th week of life of the cocks.

The birds were kept in enclosed housing in accordance with the requirements given in ‘Instructions for raising a Ross 308 flock’ [16]. Flock A was kept in a poultry house on a concrete floor entirely covered with litter 7-9 cm thick. The litter consisted of rye straw. Flock B was kept in a poultry house in which one-third of the floor was a plastic slatted floor and the other two-thirds was a concrete floor covered with litter with an average thickness of 8 cm. The farm equipment was obtained from Big Dutchman, a leading company in the poultry market, and was controlled in both poultry houses by ViperTouch computers.

The poultry house where flock A was kept had two-tiered nests of the older type, placed along the long walls of the building. Eggs were collected by hand. The chicken house where flock B was kept was equipped with nests with an automatic egg conveyor, placed in the middle of the building, so that the hens had access to it from both sides. The conveyor belt inside the nest transported the eggs outside the poultry house, which greatly accelerated and facilitated the work of the staff. In addition, the nests were equipped with an automatic expulsion system that kept the hens out of the nests at night. In both houses, daylight lasted for 14 hours. The hens were fed complete feeds in a restricted feeding system (Table 1).

Table 1
Nutritional value of feeds used in the pre-laying and laying periods

Ingredients	Type of feed – period of use (weeks)			
	pre-laying	laying period		cocks
	hens	hens		
	15-23	24-45	>45	≥20
Crude protein (%)	14.5-15.0	14.5-15.5	14.0-14.5	12.0-13.0
ME (MJ)	11.3	11.7	11.7	10.7
Fat (%)	3.5-4.5	4.0-5.0	4.0-5.0	3.0-4.0
Lysine	0.56	0.56	0.55	0.42
Methionine+cysteine	0.50	0.53	0.52	0.36
Methionine	0.28	0.29	0.28	0.18
Ca	1.0	3.0	3.3	0.9
P (available)	0.35	0.34	0.33	0.33

During the laying period, the amount and type of feed given to the birds in both flocks were recorded in detail. The data were used to calculate feed consumption for the production of one hatching egg during the laying period, whereas the feed intake in the flock was calculated jointly for both females and males. The following indicators were also analysed:

- length of laying period
- number of eggs obtained
  – from the flock in each week
  – according to quality classes
  – according to where the egg was laid
  – per hen for the entire period

Statistical analysis of the results was performed. Differences between flocks for the traits analysed were verified by Student's t-test (Statistica 13).

Results and discussion

Table 2 shows the total number of eggs laid in flocks A and B, including the number of hatching eggs and the average number of eggs obtained per laying hen, as well as selected indicators of feed consumption by the hens during the period of use. Over a period of 266 days, a total of 1,643,357 eggs were obtained from flock A, which was kept on a concrete floor covered with litter, while 1,604,144 eggs were obtained from flock B, kept on a partly slatted and partly litter-covered floor. During the entire period of use, hens from flock A consumed a total of about 392.9 tonnes of concentrate feed, while B flock consumed 405.1 tonnes. Fewer total eggs (179.7 eggs/layer) and hatching eggs (168.2 eggs/layer) were obtained from hens from flock A than from hens from flock B (187.4 and 175.6 eggs/layer, respectively). Feed intake during the laying period was also lower (40.80 and 42.02 kg/layer, respectively). The differences between flocks for these traits were statistically non-significant. Feed consumption per egg and per hatching egg was higher in flock A than in flock B – 227.0 and 242.6 kg, and 224.3 and 239.4 g, respectively (no statistically confirmed differences, Table 2). In a study by Sokołowicz et al. [32], feed consumption for the production of one hatching egg in a flock of Ross 308 meat chickens depended on the month of laying and was 1.905 kg in the first month, 0.449 kg in the fourth, and 0.399 kg in the ninth. It should be added that, according to the authors [32], feed consumption for the production of one hatching egg depends mainly on the laying rate and the share of unusable eggs.

Table 2
Laying and feed consumption parameters in flocks A and B during the period of use

Parameter	Flock	
	A	B
Total number of eggs obtained from flock in entire laying period	1 643 357	1 604 144
Total number of hatching eggs obtained from flock in entire laying period	1 538 182	1 503 136
Number of eggs obtained per laying hen	179.7	187.4
Number of hatching eggs obtained per laying hen	168.2	175.6
Total feed consumption by flock (kg)	392 920.5	405 136.5
Total feed consumption per laying hen during the period of use (kg)	48.81	49.71
Feed consumption per egg (g)	227.0	224.3
Feed consumption per hatching egg (g)	242.6	239.4

The laying rates in a flock of hens are described by a laying curve. Initially, the laying rate increases, and after reaching its peak it gradually decreases. In the flocks under study, the total laying rate was over 80% in flocks A and B – 84.0 and 86.9%, respectively – in week 27 of life, i.e. one month from the start of egg laying. In flock A, a laying rate above 80% persisted for 9 weeks, i.e. up to the 37th week of life, and in flock B for 16 weeks, i.e. to the 42nd week life. Thus the average laying rate in flock B was clearly higher (72.9%) than in flock A (67.7%). In the following weeks, there was a steady and systematic decrease in laying of hatching eggs: to 50.0% in flock A and to 59.1% in flock B (Fig.).

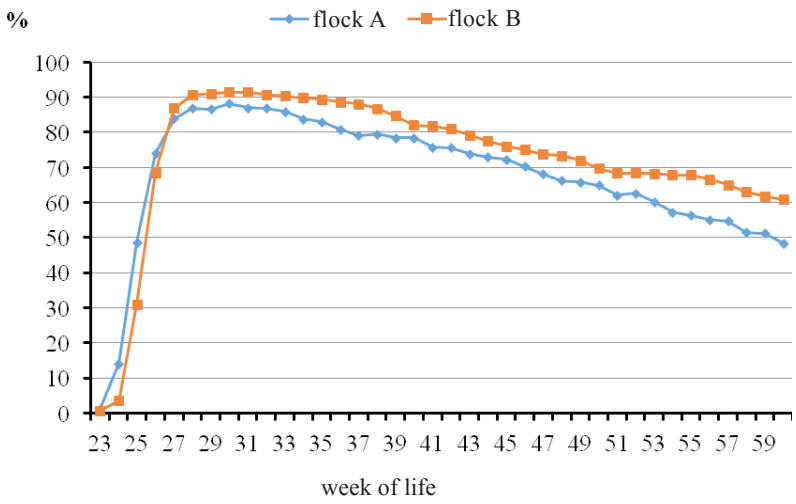

Fig. Laying rate of hens (%) in each week of life

In the study by Sokołowicz et al. [32], the flock of Ross 308 hens reached an egg-laying rate of 67.87% in the first month of laying, and reached its peak (85.14%) in the second month. The flock was liquidated in the ninth month of use at 38.72% production of hatching eggs.

In breeding flocks, laying of eggs outside the nests is an important problem. Table 3 shows the percentages of eggs laid inside and outside the nests. In the case of the hens housed on litter with standard nests and manual egg collection (flock A), the number and percentage of eggs laid outside the nest (3.1%) was much smaller than in the flock kept in a litter/slatted floor system with group nests and automatic egg collection (flock B – 9.8%). The difference is considerable, given the large size of the flocks, from which more than ten thousand eggs are obtained daily, but it was not confirmed statistically. Taking into account the entire laying period, in flock A 96.9% of eggs were laid in nests, and in flock B 90.2%. Just before laying the egg, the hen looks for a quiet place where she will not be

exposed to aggression from other hens when the oviduct is partially everted. If the nests are uncomfortable or there are not enough of them, the hens lay their eggs in dark places, under feeders or drinkers. To reduce the laying of eggs on litter, outside of the nests, at the beginning of the laying period it is often necessary to collect the eggs laid on litter and calmly move the hens sitting there to the nests. If necessary, the nests can be made more attractive in the early laying period by leaving the first eggs in the nests longer and by lining them with fresh straw.

Table 3
Percentage share of eggs (%) depending on where they were laid

Item	Flock	
	A	B
Total eggs (%) of which:	100.0	100.0
eggs from nests (%)	96.9	90.2
eggs from outside of nests (%)	3.1	9.8

It is well known that younger hens lay eggs of lower weight and that the weight of eggs increases with each week until they reach the weight characteristic of a given genotype. Table 4 presents the average weight of eggs laid by hens on selected days. Irrespective of the housing system, the hens laid eggs of similar weight, which does not confirm the observations of other authors. The influence of the housing system on egg weight has been demonstrated by Clercii et al. [7], Piśtekova et al. [27], Trziszka et al. [34] and Singh et al. [29]. In our own research, in both flocks analysed, the weight of the eggs laid increased from 54.25 to 54.08 g between weeks 24 and 32 and from 69.11 to 69.12 g between weeks 53 and 60 of the life of the hens. The average weight of eggs laid for the whole laying period was 63.06 g in flock A and 62.99 g in flock B. In a study by Biesiada-Drzazga [4], the average weight of hatching eggs laid by 35-week-old Ross 308 hens was 64.4 g, and was therefore slightly lower than in the present study. In the study cited, the egg weight in the parent stock of 35-week-old Ross PM3 and Flex Hubbard chickens averaged 57.79 and 64.26 g. Numerous studies conducted in Poland indicate that irrespective of the breed of chicken, egg weight increases as the laying period progresses (usually from the 48th week of life). Krawczyk [20] found that eggs of the Green-legged partridge breed weighed on average 48.8 g in the 32nd week of life. According to Niemiec [25], young hens lay smaller eggs, but with a strong shell and good quality egg white. Egg weight increases with the age of the layers, but the shell becomes thinner and

the quality of the albumen deteriorates. It should be added that the protein content in the feed has a huge impact on egg weight. A reduction in egg weight is largely caused by a deficiency of amino acids and essential unsaturated fatty acids. It is also important to ensure the correct level of calcium, because its absorption by laying hens changes as the laying period progresses.

Table 4
Total weight of eggs at each testing time (g)

Weeks of life of hens	Flock	
	A	B
24 – 32	54.25	54.08
33 – 42	62.53	62.69
43 – 52	66.34	66.07
53 – 60	69.11	69.12
Average for entire laying period	63.06	62.99

In the production of eggs by parent stock, the number of eggs obtained from the layer is important, but the primary task is to obtain eggs that can be used for hatching. It is therefore essential to evaluate the eggs in terms of their weight, shape, and shell condition and cleanliness. In the flocks in our study, eggs were assigned to three quality classes: hatching, large, and unusable. Examples of unusable eggs were small eggs, eggs with two yolks, abnormally shaped eggs (too spherical or too elongated), and eggs with a poorly formed, cracked, or dirty shell. The percentages of eggs (%) in individual quality classes are presented in Table 5.

Table 5
Percentage of eggs (%) in each quality class

Item	Flock	
	A	B
Total eggs (%) of which:	100.0	100.0
hatching (%)	93.6	93.7
large (%)	2.7	1.7
unhatched (%)	3.8	4.6

While the share of hatching eggs among all eggs obtained was similar in the two flocks, there were differences in the other two quality classes; the hens in flock A laid more eggs classified as large and fewer eggs considered unusable than the hens in flock B. It can therefore be concluded that the housing system did not affect the number of eggs suitable for hatching, but that it did influence the number of eggs considered unusable.

During the 38-week laying period, an average of 179.7 eggs were obtained from the hens kept in the poultry house with a litter floor (flock A), including 168.2 hatching eggs, while 187.4 eggs and 175.6 hatching eggs were obtained from the hens kept in the poultry house with a slatted/litter floor (flock B). The housing system influenced the amount of feed consumed by the birds and the number of eggs laid in and outside of nests. In the litter system, 3.1% of the total number of eggs were laid outside the nest, as compared to 9.8% in the slatted/litter floor system.

To sum up, the flocks analysed were characterized by high laying rates. Irrespective of the housing system, hatching eggs in the flocks accounted for 93.6% to 93.7% of all eggs laid. Hens kept in a poultry house with a partly slatted and partly litter-covered floor consumed more feed than those kept on litter, but consumed less feed per egg produced and per hatching egg (differences not statistically confirmed).

The housing system influenced the number of eggs laid in nests and outside of them. In the litter system, 3.1% of the total number of eggs were laid outside the nest, as compared to 9.8% in the slatted/litter floor system (no statistically significant differences).

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