SUMMARY

Keywords: *broiler, welfare, productivity, meat quality, economic efficiency*

Doctoral research started with the premise that Romanian farmers can access the compensatory payments granted by the European Union only when they reduce the density of birds and nox to levels below the mandatory minimum welfare requirements.

When developing the experimental plan, it was considered that most of the farmers who apply for compensatory payments use a density of 36.52 kg/m^2 (corresponding to a population density of 16 heads/m^2), but there are also farmers who use densities of 38.18 kg/m^2 (populated with 17 heads/m^2); establishments that only want an excise tax on diesel, without compensatory payments, apply a density of 40 kg/m^2 (19 head./m^2).

National profile statistics were also taken into account, which showed the existence of differences regarding the level of performance and production costs, from one season to another, between units with the same level of technology.

Under these conditions, the experimental variables were the brood-rearing season (experiment no. 1=winter season; experiment no. 2=spring season; experiment no. 3=summer season; experiment no. 4=autumn season), with a population density of 19 heads/m^2 (lots: Lc-1, Lc-2, Lc-3, and Lc-4), 17 heads/m^2 (lots: Lexp-1, Lexp-3, Lexp-5, and Lexp-7), and 16 heads/m^2 (lots: Lexp-2, Lexp-4, Lexp-6, and Lexp-8).

The batches of chickens were accommodated in halls identical in usable area (1190 m^2) and technological equipment, and growth was carried out on permanent litter until the age of 35 days; all chickens received combined feeds with the same nutritional characteristics.

To achieve the stated goal, five main objectives were targeted: technological indicators (microclimate, administered feed); growth indicators (body weight, growth spurt, feed consumption, exits from the group); indicators regarding meat production (slaughter yield, weight of cut portions, weight of organs), meat quality indicators (pH value, sensory properties, chemical composition, calorific value), and economic efficiency indicators (European Efficiency Index, European Broiler Index, and economic balance sheet).

Results obtained in the winter season. The highest body weight at slaughter (1994.42 g) was observed in chickens raised at a density of 16 heads/m^2 (Lexp-2 batch), which was 2.70% higher than that of chickens raised at a density of 17 heads./m^2 (Lexp-1) and by 3.98% compared to chickens housed at a density of 19 heads/m^2 (Lc-1); in the same batch, Lexp-2 was also the lowest rate of exits from the herd (1.45%) lower by 0.21-0.40% compared to batches Lexp-1 and Lc-1, but also the lowest feed conversion index (1.779 kg n.c./kg gain) was lower by 8.77-19.67% compared to the other batches.

Consequent to the superior body development, the chickens from the Lexp-2 batch (16 heads/m^2) also recorded higher slaughter yields, both hot (75.32%) and cold (74.48%) and which were higher by 1.41% and by 1.53% compared to the Lc-1 group and, respectively, by 0.67 and by 1.16% than in the Lexp-1 group; the good body development of the chickens in the Lexp-2 group was also found in a higher proportion of the pieces cut from the carcasses, with levels of 41.33% for the breast (1.38-2.20% higher than Lexp-1 and Lc-1), 27.53% for thighs (with 0.32-0.60%) and 10.34% for wings (0.09-0.26%).

These results are also supported by the weight of the internal organs, which was higher in the chickens that benefited from the greatest freedom of movement (group Lexp-2), which had higher weights by 0.30-0.95% in the case of the liver, by 2.50-4.91% in the heart, and by 0.760.98% in the case of the liver compared to the chickens from the Lexp-1 and Lc-1 groups. The pH value of the meat was in the range of 6.75-6.80 (pectoral muscles) and 7.01-7.06 (thigh muscles) in the case of fresh meat and, respectively, between 6.11-6.18 (breast muscles) and 6.22-6.31 (thigh muscles) in the case of meat refrigerated for 24 hours.

From a sensory point of view, the meat obtained from the chickens from the Lexp-2 batch had higher scores for tenderness, aroma, flavor, and consistency, and that of the chickens from the Lc-1 batch had higher scores for juiciness.

In terms of chemical composition, the meat of the chickens from the Lexp-2 group was distinguished by a higher content of dry matter, of 27.09% in the pectoral muscles (higher by 0.600.71% compared to the groups Lexp-1 and Lc-1) and 28.06% in those of the thighs (higher by 0.51-0.64%). This situation was also valid for the protein content of the meat (23.28% in the chest muscles and 20.27% in the thigh muscles), as well as for the lipid content (1.80% in the pectoral muscles and 6.06% in that of the thigh).

The chemical composition of the meat also influenced its caloric value, the highest values being obtained in the chickens of the Lexp-2 group, of 153.03 kcal/100 g in the case of the pectoral muscles and of 175.55 kcal/100 g in the thighs; these levels were higher by 2.34-2.78% and, respectively, by 1.59-2.11% compared to Lexp-1 and Lc-1 groups.

The highest scores for the European Efficiency Index (315.64) and the European Broiler Index (309.28) were for the Lexp-2 batch (16 heads/m^2), higher by 10.73-10.77% compared to the Lexp-1 group and, respectively, by 20.09-20.15% compared to the Lc-1 group.

In the end, only the Lexp-2 and Lexp-1 lots obtained benefits (24508.60 lei and 10031.68 lei, respectively), while the Lc-1 lot registered a loss of 17399.64 lei.

Results obtained in the spring season. Chickens housed at a density of 16 heads/m^2 (Lexp4) achieved the best average daily gain (62.94 g/head/day) and the highest body weight at slaughter age (2243.72 g), whereas in the Lexp-3 batch, the two indicators were lower by 3.13% and 3.19%, respectively, compared to the reference batch, while in the Lc-2 batch the differences were 4.85% and 4.92 %, respectivelyf 4.92%.

The lowest values for mortality (1.21%) and the feed conversion index (1.643 kg n.c./kg gain) were also recorded in the chickens of the Lexp-4 batch, lower by 0.25-0.43% and respectively, by 5.17-18.26% compared to the Lexp-3 and Lc-2 batches.

After the chickens were slaughtered, it was found that the highest yield at slaughter was in the Lexp-4 lot (76.24% in the case of the one established hot and 75.44% for the one calculated after refrigeration), surpassing Lexp-3 by 0,73-0.78%, and Lc-2 by 1.52-1.43%.

The carcasses from the chickens in the Lexp-4 group presented a higher proportion of breast (41.98%) and thighs (28.83%), surpassing the Lexp-3 group by 1.56% and 0.89%, respectively, and batch Lc-2 by 2.30% and 1.30%, respectively.

The organs collected from the chickens of the Lexp-4 group presented weights of 63.64 g (liver), 12.83 g (hearts) and 29.12 g (thighs), being higher by 0.36%, by 3 .51% and by 0.99% compared to the Lexp-3 batch and by 1.10%, by 6.70% and by 2.34% compared to the Lc-2 batch.

From the point of view of the pH value, the obtained meat recorded levels in the normal area, while the seasonal examination revealed characteristics that were better highlighted compared to those of the winter season; hence, higher scores were awarded.

The determinations performed on the pectoral muscles highlighted higher levels of dry matter (27.12%) and proteins (23.33%) in the Lexp-4 group, the values of which were higher by 0.51-0.57% and respectively, by 0.42-0.53% compared to those obtained in Lexp-3 and Lc-2 batches; the situation was similar in the case of the chemical composition of the thigh muscles, in the sense that the Lexp-4 group had better results, the differences between it and the Lexp-3 and Lc-2 groups being 0.46-0.52% for dry matter and 0.41-0.52% for proteins.

The caloric value of the pectoral muscles recorded a maximum level in the Lexp-4 group (153.56 kcal), a value higher by 1.92% compared to the Lexp-3 Group and by 2.37% compared to the Lc-2 group; for the thigh muscles, the differences between the caloric value of the samples from the Lexp-4 group (176.41 kcal) and that from the Lexp-3 and Lc-2 groups was 0.99-1.76%.

The European Efficiency Index reached the highest rate (385.42 points) in the Lexp-4 group, 8.12% higher than that in the Lexp-3 group, and by 19.87% compared to the Lc-2 group; for the European Broiler Index, the Lexp-4 batch had higher values (378.44 points), surpassing the results of the Lexp-3 and Lc-2 batches by 8.28-19.95%.

The three experimental lots made a profit at the end of the growth series, but only 3219.31 lei for the Lc-2 lot (19 heads/m^2), compared to 32584.87 lei for the Lexp-3 lot (17 heads/m^2) and especially 43162.12 lei for the Lexp-4 lot (16 heads/m^2).

Results obtained in the summer season. The chickens in the Lexp-6 group (16 heads/m^2) achieved an average gain of 60.73 g/head/day and a weight of 2165.94 g, surpassing those of the Lexp-5 group (17 heads/m^2) with 3.21% and 3.14%, respectively, and on the chickens from batch Lc-3 (19 heads/m^2) with 4.96% and 4.86%. Specimens from the Lexp-6 batch also had the lowest mortality (1.33%) and conversion index (1.692 g n.c./kg spor), lower by 0.20% and 1.60% compared to the Lexp-5 batch, and by 0.38% and 19.98 %, respectively, compared to batch Lc-3.

The yield at slaughter correlated with the final weight of the chickens, and was better in the Lexp-6 group, both of which were established on warm carcasses (75.88%), and the yield calculated for carcasses cooled for 24 h (74.73%). In the case of the Lexp-5 batch, the hot yield was lower by 0.75% and the cold yield by 0.84%, while in the Lc-3 batch, the differences were even greater, 1.55% and 1.66 %, respectively.

The data regarding the weight of the anatomical portions indicated superior values in the same batch Lexp-6 (41.55% for the breast; 27.97% for the thighs; 10.56% for the wings), which were higher by 1.43%, 0.42%, and 0.14% compared to the situation in batch Lexp-5 and by 2.25 %, 0.80 %, and 0.37 %, respectively, compared to batch Lc-3.

The difference in freedom of movement also influenced the development of the internal organs, which registered higher weights in the chickens from the Lexp-6 group, higher by 0.38-2.85% compared to the situation in the Lexp-5 group and by 1,11-7.92% compared to batch Lc-3.

The pH value was closest between the determinations made on hot meat (6.70-6.76 in pectoral muscles and 6.96-7.02 in thighs) and those on chilled meat (6.03-6,11 in the muscles of the chest and 6.20-6.25 in those of the thighs), a consequence of the high temperatures at the time of transport and slaughter of the chickens.

This phenomenon was observed in the grades given in the organoleptic examination, which were lower than those in the previous seasons, for both muscles studied.

In the Lexp-6 group, the pectoral muscles were characterized by the highest content of dry matter (26.93%), proteins (23.06%), and lipids (1.95%), with higher values of 0.65%–0.71%, by 0.54-0.62% and by 0.13-0.17% compared to those from the Lexp-5 and Lc-3 batches.

In the case of the thigh muscles, the Lexp-6 group was also noted, in which the content of SU, proteins, and lipids was higher by 0.53%, 0.52%, and 0.02% compared to the Lexp-5 group by 0.65%, 0.66%, and 0.05%, respectively, compared to batch Lc-3.

Caloric content showed differences between the two muscle groups studied, but in both situations, it was higher in the Lexp-6 group (breast=152.87 kcal; thighs=174.38 kcal), surpassing the Lexp-5 group 2.71- 1.78%, and batch Lc-3 with 3.07-2.25%.

The best scores for the European Efficiency Index and the European Broiler Index were for the Lexp-6 batch (360.87 and 354.15 points, respectively), higher by 4.86-4.92% compared to the Lexp- 5 and by 21.0-21.09% compared to batch Lc-3.

From an economic point of view, a popular variant with 16 heads/m^2 (lot Lexp-6) was highlighted, where a benefit of 37,966.39 lei/series was obtained, compared to only 27,474.83 lei/series in the lot where population was achieved with 17 heads/m^2 (lot Lexp-5), whereas in the control lot (19 heads/m^2), the growth series was closed with a loss of 5467.35 lei.

Results obtained in the autumn season. The highest body weight at slaughter (2235.74 g) and the lowest levels of mortality (1.28%) and feed conversion rate (1.657 kg b.c./kg gain) were observed in chickens from the Lexp-8 group (16 heads/m^2); in group Lexp-7 (17 heads/m^2), weight was lower by 3.13%, mortality was higher by 0.19%, and conversion index was higher by 3.98%, while in group Lc -4 (19 heads/m^2), the differences were -4.83%, +0.37%, and +19.19%, respectively.

Naturally, the Lexp-8 batch had the best slaughter yield values of 76.12%-hot and 75.32%cold (higher by 0.78-0.83% compared to that of the Lexp-7 batch and by 1.62-1.53% compared to Lc-4), but also for the participation rate of the main anatomical parts, of 41.86% for the chest and 28.38% for the thighs (higher by 1.61-0.79% compared to the Lexp-7 group and, respectively, by
2.4-1.3% compared to Lc-4).

The weight of the edible organs collected from the chickens of the Lc-4 and Lexp-7 groups, respectively, were lower by 0.54-0.37% in the case of the liver, by 7.57-2.93% in the case of the hearts and by 2.62-0.94% for pipettes compared to those found in the Lexp-8 batch.

The pH value of the meat was normal, both immediately after slaughter (with limits of 7.07.07 for the pectoral muscles and 7.11-7.17 for the thighs) and after refrigeration (5.41- 5.46 in the pectoral muscles and 5.51-5.55 in the thighs).

The meat of chickens raised at a density of only 16 heads/m^2 (batch Lexp-8) received the highest scores for three of the evaluated sensory attributes, whereas the meat of chickens housed at a density of 19 head/m^2 (batch Lc-4) had a higher score for juiciness.

In the samples taken from the pectoral muscles of the chickens from the Lexp-8 group, the highest content of dry matter (27.05%) and proteins (23.25%), higher by 0.48% and 0.52% compared to the Lexp-7 group and, respectively, with 0.73% and 0.64% compared to the Lc-4 group. There was a similar ranking for the chemical composition of the thigh muscles, the Lexp8 batch standing out with higher dry matter contents (higher by 0.48-0.73% compared to the Lexp7 and Lc-4 batches), proteins (higher by 0.52-0.64%) and lipids (higher by 0.09-0.11%).

The highest caloric content was found in chicken meat from the Lexp-8 group (152.69 kcal in the pectoral muscles and 175.48 kcal in the thighs), higher by 2.12-1.74% compared to that from batch Lexp-7 and by 2.99-2.43% compared to batch Lc-4.

The superior performance achieved by the chickens from the Lexp-8 batch resulted in high values of the European Efficiency Index (398.61) and the European Broiler Index (384.49), which exceeded by 11.23-10.85 % the results of the chickens from the Lexp-7 batch and by 24.78-24.49% those of the chickens from the Lc-4 batch.

At the economic level, the same batch Lexp-8 stood out, which resulted in a benefit of 41366.65 lei; there were also good results for the Lexp-7 batch, with a benefit of 31321.39 lei, while the Lc-4 batch had a loss of 253.98 lei.

The final conclusion derived from the research that focused on the effects of the application of the Union's welfare rules on the technical-economic parameters specific to the growth and exploitation of broiler chickens was that they are categorically influenced by the density used, but also that the season in which growth takes place exerts a certain degree of influence, at least in the climatic conditions of our country.

Based on the aforementioned, we make the following recommendations:

- raising broiler chickens in superior welfare conditions (reducing density by 15% and noxes by 30%) ensures profitability in meat production and contributes to protecting the environment;
- the identification of technological measures that allow the reduction of production costs in too cold or too hot periods of the year;
- continuing research in this direction to find other scientific arguments that motivate breeders to adopt welfare measures specific to broilers.