ABSTRACT

Keywords: **hens, loft, performances, eggs, quality**

It is well known the fact that eggs' production is under the dependency of various endogen and exogenous factors, which have an influence rate in variable limits.

Even, if during time, were effectuated numerous research regarding this problem (in sphere of genetics, physiology, ethology and birds' nutrition), the last period was dedicated especially to study of rearing system action on productivity of laying hens.

The aim of our research is in the spirit of the above mentioned things, because presume evaluation on scientific basis of the productive performances recorded by laying hens and on quality of eggs laid by them, in case of application of rearing techniques in lofts, system less utilised in Romania, even if it has a greater reliability and more of that respects the welfare conditions.

To achieve this goal were studied two exploitation systems for laying hens agreed at European level, such as: in improved batteries (Big Dutchman, Eurovent type) and respectively in loft (Natura Nova Twin).

Investigations were realised in parallel for those two rearing systems considered as experimental variable and included common targets and activities, specific for rearing and exploitation sector of hens specialized in egg production.

Regarding technical-economical parameters based on which was realised the differentiation between those two rearing systems, the aims were to establish the productive indicators during hens' rearing and exploitation, as follows: dynamics of corporal weight; egg production (numerical, laying intensity, commercial structure); proportion of flock keeping (mortality rate and causes for outflows from flock) and fodder consumption (total, daily mean and conversion index).

Another important component of our research was determination of indicators which reveal the quality of obtained eggs in those two compared rearing systems.

In this way, were studied external quality elements (weight, form, specific weight, shell thickness), internal quality elements [albumen index, yolk index, Haugh index, eggs' structure, yolk colour and chemical composition: water, proteins, lipids, mineral substances, amino acids and fatty acids), as well as microbiological contamination degree of mineral shell (TNG)].

At the end, we establish the economical efficiency for laying hens exploitation in those two rearing systems; in this way were calculated the total production costs (direct and indirect expenditures), costs realised with production processing (sorting, packaging and delivery), as well as revenues and benefits realised.

To counteract the influence of other experimental factors that the ones proposed by us, was tracked the assured microclimate in those two studied shelters (temperature, relative moisture and emissions), as well as quality of food administrated to birds (structure and quality conditions for each charge/transport of mixed fodders).

The main ambient factors from those two studied shelters were assured at quite near levels to the ones for laying hens specific physiological necessary.

For example, oscillations limits for ambient temperature were +20.46...+21.86ºC in case of shelter equipped with battery and +17.97...+24.63ºC for shelter equipped with loft where existed an excess of biological heat (triple number of accommodated hens), which imposed a suitable increasing of ventilation, which in association with the very large area of shelter generated variations of temperature.

Air relative moisture had a low variation in shelter equipped with batteries (56.43….58.14%), but presented quite large oscillation limits in the one equipped with loft (55.0…74.57%), phenomenon due to water excess originated from dejections and birds' (a greater number of individuals on built area) and from technological evaporative water (from drinkers and from PAD cooling system).

Emissions' dosing in those two studied shelters was made in according with the welfare legislation. From this point of view for carbon dioxide were founded concentrations of 350-1000 ppm in shelter with loft and 350-680 ppm in shelter with battery (welfare norms=max. 2100 ppm), and for ammonia 6-31 ppm in shelter with loft and 3-15 ppm in the one with battery (welfare norms=max. 14 ppm).

Those two birds batches were from own source (was subjected to a photo-stimulation programme for accumulation of reserves needed in laying period), so their corporal weight was higher than the standard of utilised hybrid.

In experimental period, hens reared in loft laid a number of 254.49 eggs/head, and the ones from battery 258.08 eggs/head, productions higher with 2.20% (the ones from loft) and respectively, with 3.64% (the ones from battery) than the theoretical potential of ISA Brown hybrid (249 eggs).

During the whole studied period, mean laying intensity of hens reared in battery was 89.88% and for the ones reared in loft was 88.66% (theoretically=89.29%).

Maximum laying intensity was reached in week 31, with levels of 93.30% for hens from loft and 93.85% at the ones from battery.

At the hens from shelter equipped with loft, daily mean consumption for the whole studied period was 120.17 g m.f./day/head, and food conversing index was 135.34 g m.f./egg, while at hens accommodated in shelter with batteries those two parameters were better, with levels of 115.29 g m.f./day/head respectively 127.66 g m.f./egg.

On whole period (20-60 weeks), outflows from flock were situated at a level of 6.41% for hens reared in loft and 4.26% for the ones accommodated in battery.

At hens from loft, outflows from flock were due to mechanical accidents (51.7% vs. 42.1% in battery) caused by equipment particularities. At hens accommodated in battery, mortality appeared due to an advanced exhaustion; besides, those hens presented a higher incidence of obstetrical diseases (34.7% vs. 29.6%) and internal ones (23.2% vs. 18.7%) caused by a more intense laying rhythm.

From the obtained data regarding biochemical indicators for the studied birds, resulted that their level depends on laying intensity and physical effort (movement) effectuated by them. So, in comparison with the birds at the beginning of laying presented superior levels for proteins (higher with 21.2-25.7%), triglycerides (with 4.7-5.4%) and cholesterol (with 39.5-43.0%).

Minerals from blood were determined in lower quantities during laying peak (Ca=8.17-8.98 ml/dl; P=6.12-6.58 ml/dl) and higher at end of laying (Ca=11.03-11.89 ml/dl; P=7.93-8.63 ml/dl), situation valuable also for sanguine enzymes, whose values were higher at the end of laying (with 8.3-8.5% in case of alanine aminotransferase and respectively, with 22.8-23.2% in case of aspartate aminotrasferase), than at beginning of laying.

Eggs with deviations from normal morphology were founded into a mean rate of 1.43% at hens reared in shelter with battery and 1.36% at the ones from loft.

Mean weight of eggs gathered from hens accommodated in battery was 58.99 g, with limits of 47.75-67.42 g, and for the ones gathered from hens accommodated in loft was 59.23 g, with limits of 47.89-67.95 g.

For format index resulted a mean value of 77.97% for eggs gathered from hens in battery and 78.42% for the ones from loft, for eggs' volume values were 58.12 cm^3 (battery) and 58.54 cm^3 (loft), and for eggs' specific weight values were 1.093 and respectively 1.094.

Shell thickness recorded a mean level of 0.363 mm at eggs from hens reared in battery and 0.381 mm at the ones from loft, from where appeared differences between batches regarding shells' breaking up resistance (0.332 kgf/cm^2 vs. 0.329 kgf/cm^2).

From evaluation of studied eggs' structure resulted that the ones provided by hens reared in loft had a little bit higher mean levels for yolk (31.69% vs. 31.64%) and for mineral shell (10.92% vs. 10.85%), while for eggs from hens accommodated in shelter equipped with loft albumen was predominant (57.49% vs. 57.40%).

Mean values calculated for albumen index were 0.211 (shelter equipped with battery) and 0.222 (shelter equipped with loft), the ones for yolk index were 0.456 (battery) and 0.472 (loft), and the ones for HU were 96.10 HU respectively 96.67 HU.

Regarding yolk colour, existed differences between gathering periods, due to the administrated mixed fodder; mean score calculated for eggs provided by rearing in battery was 9.88 colour units and the one for eggs gathered from loft was 9.99 colour units.

Chemical composition of yolk, respectively albumen didn't presented significant differences between those two egg batches, mentioning that a little bit higher levels were at eggs laid by hens reared in loft; so, mean content in dry matter of yolk from the above mentioned eggs was 9.08 g face to 8.99 g for eggs from battery and the one for albumen was 4.18 g face to 4.16 g from battery.

Mineral substances from eggs' shell were founded in mean quantities of 6.94 g for the ones provided by rearing in loft and 6.73 g at the ones from battery.

From analysis of data regarding amino acids profile in albumen resulted that the essential ones were in quantities of 32.724 g/100 g DM (rearing in loft) and 32.430 g/100 g DM (rearing in battery), semi-essential amino acids were in quantities of 17.153 g/100 g DM (loft) and 16.748 g/100 g DM (battery), and the non-essential ones were 29.752 g/100 g DM (loft) and 30.008 g/100 g DM (battery).

Total quantity of amino acids existent in albumen of the studied eggs was 79.629 g/100 g DM at hens accommodated in loft and 79.186 g/100 g DM at the ones reared in shelter equipped with battery.

Total quantity of fatty acids from yolk was equal at those two egg batches, 99.985 g FAME/100 g total FAME, but with differences between categories of acids (essential fatty acids: 35.525 g-rearing in loft and 35.425 g-rearing in battery; monounsaturated fatty acids: 37,855 g-rearing in loft and 37.835 g rearing in battery; polyunsaturated fatty acids: 26.605 g-rearing in loft and 26.725 g-rearing in battery.

Ratio saturated fatty acids/total unsaturated fatty acids (SFA/UFA) was 0.551 at eggs from the hens in loft and 0.548 at the ones from battery, and rate polyunsaturated fatty acids/monounsaturated fatty acids (PUFA/MUFA) was 0.702 at eggs from loft and 0.706 at the ones from battery.

Rate omega 6 acids/omega 3 acids was 15.576 at eggs laid by hens reared in loft (Ω6=25.000 g; Ω3=1.605 g) and 15.703 at the ones from battery (Ω6=25.125 g; Ω3=1.600 g).

Microbiological charge of egg shell varied significant between those two bird batches, with mean levels of 231.58 germs/cm^2 for the ones reared in battery and respectively 249.50 germs/cm^2 for the ones accommodated in loft.

In case of hens reared in loft, the total production costs summed 620,688 lei and incomes were 676,242 lei, resulting a benefit of 55,554 lei/10000 introduced hens respectively, 5.55 lei/bird.

For rearing system in battery, total production expenditures were 605,399 lei, incomes totalized 668,289 lei, and final benefit was situated at a level of 62,890 lei/10000 introduced hens (6.28 lei/bird). The conclusion of our research was that, nowadays, exploitation system of laying hens in unconventional ecological batteries, is the most productive and efficient rearing system, because allow realisation of some productions very close to hybrids' genetic potential, a superior economical efficiency for egg production, as well as an optimal utilization of production spaces.

But of course, must be mentioned the advantages of rearing of hens in lofts and especially the fact that respects the actual welfare norms, so this rearing system could be seriously consider by the poultry breeders from Romania, having in view that ecological associations and animals' protection leagues are determined to ban the usage of batteries for poultry rearing into a not to far future.

Based on the above mentioned things we make some recommendations for poultry rearing practice in Romania:

- adoptation by the specialized farms in consumption eggs production of those exploitation systems which respects the animal welfare norms but also assure the economical efficiency of egg production;
- assuring at an optimal level of all technological factors specific for rearing of laying hens, to allow them the externalization of productive potential;
- elimination/limitation of perturbatory factors from avian farms, because affects the hens' welfare and especially their productivity;
- maintenance decontamination of rearing spaces, together with the imposed decontamination of eggs in sorting station, because those ones have a high contamination degree of shell, no matter of the utilised rearing system.