Organic farming production. Effect of age on the productive yield and egg quality of hens of two commercial hybrid lines and two local breeds

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ABSTRACT

Hens of 2 hybrid lines (Hy Line Brown - HLB, Hy Line White - HLW) and 2 local breeds (Robusta maculata – RM and Ermellinata of Rovigo – ER) were reared following the organic production procedure and their egg yield and quality were studied at two different ages (30 and 42 weeks). The experimental period was between 26 and 42 weeks of age, starting in summer and lasting until autumn. Age significantly (P<0.01) affected the hen-day egg production and the daily egg mass of the HLB (84 vs. 94% and 44.5 vs. 59.4 g), of the HLW (81 vs. 89% and 42.4 vs. 54.7 g) and of the RM hens (27 vs. 63% and 12.9 vs. 36.7 g), which was the least precocious. Age did not affect the daily egg production of the ER hens (which was maintained around 58%), although it was observed a slight (P<0.05) increase of the daily egg mass (28.6 vs. 32.1 g). Age increased (P<0.01) the egg weight, yolk colour, yolk percentage and yolk:albumen ratio and decreased the albumen percentage in all groups.

Key words: Organic farming, Laying hen, Genotype, Egg quality

Introduction

In the organic farming production regulation (OJEC, 1999) the use of local breeds is preferred as respect to the use of other genotypes because they are supposed to be more adaptable and rustic under less controlled conditions of rearing. For intensively reared commercial hybrid lines (Bell, 2002) the effect of age and environment on the quality of eggs is well known.

In this trial the effect of age on the productive performance and on the quality of eggs of hens belonging to two hybrids and two local breeds kept under organic farming circumstances was evaluated in the first phase of oviposition.

Material and methods

Laying hens of four genetic types (70 birds per type): 2 commercial hybrid lines, brown egg line (Hy-Line Brown- HLB) and white egg line (Hy-Line White - HLW) and two Italian (Veneto) dual-purpose breeds, Robusta maculata (brown egg – RM) and Ermellinata of Rovigo (light-brown egg - ER) were reared under the same circumstances. The environmental conditions changed widely throughout the experimental period: the temperature and the relative humidity ranged from about 30 to 5°C and from 70 to 75%, respectively. The photoperiod was maintained constant (16 h of light and 8 h of dark) by means of artificial light according to the season. The hens received ad libitum the same diet through the whole experimental period (crude protein=18.70%; metabolizable energy=11.82 MJ/kg; calcium=3.80%;...
The increase of the feed:egg ratio according to the age and the season, in the HLB and ER groups could be due to a higher energy and nutrient demand for thermoregulation and body growth. At 42 weeks the RM hens showed, as respect to the earlier age, a more favourable feed:egg ratio, probably due to a decreasing incidence of energy and nutrients used for growth as respect to that used for egg production. These results are in agreement with the observation that during the trial the local dual-purpose breeds presented higher body gain with respect to the hybrid lines (Rizzi et al., 2004). The RM hens probably present a higher and more precocious muscle growth and start laying eggs later, and the ER hens start egg production earlier but present a more gradual development of body weight in comparison to the RM hens.

In table 2 some egg quality parameters are reported. Age significantly (P<0.01) influenced the egg weight in all groups. The effect of age on eggshell quality was limited: the thickness did not change with the exception of the HLB eggs which showed lower (P<0.05) values at 42 weeks. The incidence of the eggshell on the total weight of the egg decreased (P<0.05) only in the HLB and ER groups. The yolk colour increased (P<0.01) with the age of the animals in all groups. Age significantly (P<0.01) increased the proportion of yolk and decreased (P<0.01) the incidence of albumen, particularly in the local breeds. The yolk:albumen ratio was always increased by age (P<0.01), but the ER and RM eggs showed the highest values.

Age may affect the quality of the egg: the yolk colour is affected not only by the intake of carotenoid pigments but also by the body synthesis of lipids. In agreement

| Table 1. Effect of age on productive yield of the laying hens. |
|---------------------------------------------------------------|
| HLB | HLW | RM | ER |
| --- | --- | --- | --- |
| Hen-day egg yield, % | 30 wk | 42 wk | 30 wk | 42 wk | 30 wk | 42 wk | 30 wk | 42 wk |
| Root MSE | 84.2\textsuperscript{A} | 94.1\textsuperscript{B} | 80.7\textsuperscript{A} | 88.7\textsuperscript{B} | 27.1\textsuperscript{A} | 63.0\textsuperscript{B} | 59.0 | 56.8 |
| Egg mass, g/d | Root MSE | 44.5\textsuperscript{A} | 59.4\textsuperscript{B} | 42.4\textsuperscript{A} | 54.7\textsuperscript{B} | 12.9\textsuperscript{A} | 36.7\textsuperscript{B} | 28.6\textsuperscript{A} | 32.1\textsuperscript{B} |
| Feed:egg, g/g | Root MSE | 1.89\textsuperscript{A} | 2.48\textsuperscript{B} | 2.17 | 2.10 | 9.26\textsuperscript{B} | 3.61\textsuperscript{A} | 3.13\textsuperscript{A} | 4.30\textsuperscript{B} |

\textsuperscript{a, b}: P<0.05; \textsuperscript{A, B}: P<0.01; HLB=Hy Line Brown, HLW=Hy Line White, RM=Robusta maculata, ER=Ermellinata of Rovigo; 30 and 42 wk=30 and 42 weeks of age; degrees of freedom=54

Phosphorus=0.70%). The hen-day egg production (number of eggs/number of live hens x 100), the daily egg mass and the feed:gain ratio were recorded during the four weeks preceding the 30\textsuperscript{a} and the 42\textsuperscript{d} week of age. Samples of about 30 eggs per genotype, collected at 30 and 42 weeks of age, were analysed to evaluate the weights of egg, yolk, albumen and eggshell, the yolk colour (by means of a colour Roche scale) and the eggshell thickness (by means of a digital micrometer).

Data were subjected to analysis of variance (SAS, 1996).

Results and conclusions

Age significantly (P<0.01) increased the hen-day egg production (Table 1) in both the two hybrid lines and in RM, where the daily egg yield doubled passing from 30 to 42 weeks of age. The daily egg yield of ER was unaffected by age.

Age had significant effects on the daily egg mass in all the genetic lines: HLB and HLW presented a similar increase (P<0.01), the RM hens showed a final egg mass about 3 times higher (P<0.01) than that observed at 30 weeks of age, whereas the increase of the ER daily egg mass was less marked (P<0.05). These data indicated that, under the rearing circumstances adopted, the hybrid lines reached the peak of the production curve later than the age normally reported by Hy Line Ltd. RM hens started laying later with respect to the other groups and the number and the weight of the eggs increased markedly with age. The ER hens demonstrated a rather constant production from 30 to 42 weeks of age.

Age had also significant effects on the measured feed:egg ratio which increased in HLB and in ER and decreased in RM. No effect of age on this parameter was observed for the HLW group of hens. The increase of the feed:egg ratio according to the age and the season, in the HLB and ER groups could be due to an higher energy and nutrient demand for thermoregulation and body growth. At 42 weeks the RM hens showed, as respect to the earlier age, a more favourable feed:egg ratio, probably due to a decreasing incidence of energy and nutrients used for growth as respect to that used for egg production. These results are in agreement with the observation that during the trial the local dual-purpose breeds presented higher body gain with respect to the hybrid lines (Rizzi et al., 2004). The RM hens probably present a higher and more precocious muscle growth and start laying eggs later, and the ER hens start egg production earlier but present a more gradual development of body weight in comparison to the RM hens.

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Age may affect the quality of the egg: the yolk colour is affected not only by the intake of carotenoid pigments but also by the body synthesis of lipids. In agreement
with the results of Silversides and Scott (2001), the weight of yolk increased with age more than did the albumen. In our trial the higher increasing of weight were observed for the yolks of the local pure breeds. These results confirm that the genetic improvement of selected lines of hens has involved the weight of the egg and their protein fraction rather than the lipid fraction (Suk and Park, 2001). So the hybrid lines, especially HLB, present a yolk incidence lower than that of local breeds.

The data demonstrate that in the first phase of production, from 30 to 42 weeks of age, and under our experimental conditions, significant change in the egg yield and quality can be expected: the commercial hybrid lines and the RM breed increased the number of eggs produced per day; the daily egg mass increased in all the four genetic stocks. The feed:egg ratio increased in the HLB and ER hens which presented higher body growth than HLW, whereas in the RM hens the ratio decreased because these hens started laying later than those of the other groups. Age increased the egg weight, yolk colour and yolk:albumen ratio in all groups; the eggshell thickness and eggshell percentage decreased in the HLB and ER eggs. In conclusion this work provides some information which can be useful for the organic farmers to improve their strategy of production and marketing.

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### Table 2. Effect of age on various egg quality parameters.

|       | Egg weight | Eggshell thickness | Yolk colour Roche | Yolk % | Albumen % | Eggshell % | Yolk:Albumen ratio |
|-------|------------|-------------------|-------------------|--------|-----------|------------|-------------------|
| HLB   | 30 wk      | 56.9 A            | 376b              | 7.30A  | 23.36A    | 65.22B     | 11.42B            | 0.36A             |
|       | 42 wk      | 66.11B            | 364a              | 9.70B  | 25.23B    | 64.30a     | 10.47A            | 0.39B             |
|       | Root MSE   | 3.88              | 19                | 0.5960 | 1.2918    | 1.5389     | 0.8708            | 0.0286            |
| HLW   | 30 wk      | 55.5 A            | 342               | 7.20A  | 24.47A    | 65.22B     | 10.31             | 0.38A             |
|       | 42 wk      | 63.98 B           | 347               | 9.64B  | 27.13B    | 62.55A     | 10.32             | 0.44B             |
|       | Root MSE   | 3.89              | 22                | 0.6973 | 1.5029    | 1.5356     | 0.5674            | 0.0335            |
| RM    | 30 wk      | 52.5 A            | 373               | 7.35A  | 26.33A    | 62.85B     | 10.82             | 0.42A             |
|       | 42 wk      | 60.33 B           | 383               | 10.21B | 29.77B    | 58.93A     | 11.30             | 0.51B             |
|       | Root MSE   | 2.93              | 28                | 0.8068 | 1.4415    | 1.5114     | 0.8838            | 0.0366            |
| ER    | 30 wk      | 51.2 A            | 338               | 7.55A  | 27.91A    | 62.00B     | 10.08B            | 0.45A             |
|       | 42 wk      | 58.88 B           | 322               | 10.00B | 31.40B    | 59.10A     | 9.50A             | 0.53B             |
|       | Root MSE   | 3.69              | 33                | 0.7818 | 1.4888    | 1.7915     | 0.7936            | 0.0396            |

a, b: P<0.05; A, B: P<0.01; HLB=Hy Line Brown, HLW=Hy Line White, RM=Robusta maculata, ER= Ermellinata of Rovigo; 30 and 42 wk=30 and 42 weeks of age; degrees of freedom: HLB=58; HLW=56; RM=44; ER=51