Physico-chemical characteristics of eggs from two Italian autochthonous chicken breeds: Modenese and Romagnolo.

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The safeguard of biodiversity is an important objective of poultry production in Italy. Two autochthonous chicken breeds are still present in the Emilia-Romagna region: Modenese (MOD) and Romagnolo (ROM), that are white eared light breeds of Mediterranean class. They are mainly used in organic farming production, because of their resistance to open air housing conditions. With the aim to improve the knowledge about egg characteristics, 25 females from each breed, obtained from the nucleus flock at the Faculty of Veterinary Medicine of Parma, born between May and June 2004, were raised outdoor in four 7 x 7 m paddocks (about 4m²/hen), and the production cycle was then controlled from February to October 2005 (38 weeks). Egg production was daily recorded; eggs were weighted and measured (length, L; maximum breadth, B); shape index was calculated as (B/L)*100. Surface color was determined by Minolta Chromameter Reflectance II CR100/08 and expressed as L* a* b*. Hue and chrome were calculated. The percentage of egg components (yolk, albumen, shell), their chemical composition and shell thickness were determined on a sample of 30 eggs per breed. All the parameters were also obtained on a sample of white and brown commercial eggs. Data were submitted to ANOVA (fixed factor: breed). Egg production was higher in MOD than in ROM (+5.9%). Eggs produced by local breeds were significantly (P<0.05) lighter and smaller than commercial, as the shape was similar to commercial white eggs. MOD eggs were significantly (P<0.05) shorter (-0.54%) than ROM; the shape index indicates that MOD eggs were significantly less outstretched than ROM, and, as a consequence, more resistant. Shell color parameters indicated lower b* values and chrome (P<0.05) in ROM eggs than in MOD, probably due to lower pigment mobilization, as confirmed by the typical depigmented skin in ROM breed. MOD eggs showed a lower albumen incidence and a higher yolk incidence (P<0.05) on total egg weight than ROM. Shell thickness was lower in MOD eggs (-8.1%; P<0.05) than in ROM. The chemical composition of egg components showed little differences between the two local breeds.

Keywords: egg; Modenese hen; Romagnolo hen; autochthonous breeds

Introduction

Egg production in Italy, as well as in the other developed Countries, is obtained by commercial strains of hens, selected for improved performance and reared indoor. The problems of animal welfare suggest to deepen the studies about the use of local breeds, particularly suitable for outdoor rearing systems. Moreover, the protection of biodiversity in animal production today appears as a primary objective, bound not only to the increase of the sensibility in the public opinion towards the safeguard of autochthonous animal breeds and to the quality of newly discovered food products, but also to the ascertainment of the progressive reduction of the genetic variability in the so called cosmopolite
breeds. Such loss of variability must seriously worry, because it renders the animals less flexible in
their answers to unexpected environmental variations, or to unknown or emerging pathologies;
moreover, it exposes animal productions to a quasi-qualitative flattening, with a negative recoil for
the consumer, and it contributes to the reduction of the zootechnical activity in the areas with lower
economic potentialities.

Recently, Zanon and Sabbioni (2001) led a surveying, about the identification of the autochthonous
avian breeds and the estimate of their presence in Italy. They concluded that approximately 61% of the
known breeds must be considered as extinct, 13% threatened, 17% scarcely diffuse and 9% diffused.
The indications of the research orient towards a serious worry in the maintenance of the biodiversity in
aviculture.

With the aim to contribute to the safeguard of two local breeds of fowls native of Emilia-Romagna
region, the following research deepens the study of egg production characteristics, so to obtain useful
data for their eventual re-introduction in the productive system and, therefore, for an “in situ”
safeguard (Pagnacco, 1997). It is obvious that such activity does not take place as an alternative to the
intensive aviculture, but simply it represents a complement; it could be useful for particular production
systems, such as the open air rearing or the organic farming.

The two local breeds object of this study are the Modenese and the Romagnolo, both light breeds of
Mediterranean stock, white ear-lobed and traditionally used in the areas of origin as dual purpose
breeds to meet family needs for egg and meat supplying (Sabbioni et al., 2006) and not for commercial
purpose.

Modenese breed is characterized by the presence of medium-large animals (live weight in males kg
2.5-3.2, in females kg 1.9-2.6) with golden or blue golden wheat plumage (Mazzon, 1932). It produces
white shell eggs. During the past century the breed was crossed with the ancestral Italian Leghorn
(black red), to improve egg production. The actual consistency, due to the activity of safeguard at the
University of Parma, is approximately 600 breeders, distributed essentially in the provinces of Parma,
Reggio Emilia and Modena.

Romagnolo breed is lower in size (Zanon, 2001), characterized by a simple comb of medium
wideness, straight in the male and folded in the hen, of intense red colour, fine webbing without
presence of granulations. The wattles are somewhat developed, the large ear-lobes are oval in shape,
small, cream coloured, smooth, sometimes blue shadowed, especially in the young animals. The skin
colour is varied and it can be pale yellow or white-grey. The shanks vary from yellow to green and
totally dark. The plumage is somewhat varied, as it results from the few photos of the past century, but
the silver, the grey "silver black ribbons", the golden red "gold black ribbons", the white and the
partridge are common. The weight of the male ranges between 2.0 and 2.5 kg, that of the hen is of
approximately 2.0 kg. The Romagnolo fowl is considered particularly sturdy and with a "wild"
behaviour that pushes it, having the possibility, to pass the night on the trees, rather than in the hen
house. Because of its geographic localization in areas not far from areas voted to the avicultural
breeding of intensive type, the Romagnolo fowl, in the past century underwent numerous crosses and
it was gradually replaced with more precocious and productive breeds. The actual consistency, due to
the activity of safeguard at the University of Parma, is approximately 800 breeders, distributed
essentially in the provinces of Parma, Modena, Forlì-Cesena and Ravenna.

The aim of the research was to assess some egg production and quality parameters of Modenese
and Romagnolo hens, reared outdoor in semi-intensive conditions.

Material and methods

Twenty-five Modenese (MOD) and 25 Romagnolo (ROM) hens, obtained from the nucleus flock at
the Faculty of Veterinary Medicine of Parma, born between May and June 2004, were raised outdoor
in four 7 x 7 m paddocks (about 4m²/hen) and fed with pasture and a commercial pelleted diet (16%
crude protein) ad libitum; the production cycle was then controlled from its starting (February to
October 2005; duration: 38 weeks). Water was available ad libitum. Egg production was daily
recorded by group and average weekly production/hen then calculated; all eggs were individually
weighted and measured (length, L; maximum breadth, B); the shape index was calculated as
(B/L)*100 (Commissione Metodologie di Valutazione delle Produzioni delle Piccole Specie, 1996).
On a sample of 1700 eggs, surface colour parameters were determined by Minolta Chromameter Reflectance II CR100/08 with C illuminant (6774 K), and expressed as L* a* b*. Hue and chrome were calculated as arctg(b*/a*) and √(a*² + b*²), respectively.

The percentage of egg components (yolk, albumen, shell) and their chemical composition (AOAC, 1990) were determined on a sample of 30 eggs per breed randomly chosen, following the method proposed by Van den Brand et al. (2004). All the above said parameters were also obtained on a sample of white and brown commercial eggs for comparisons. Eggshell thickness was measured only in MOD and ROM eggs by means of a micrometric gauge, measuring at least 5 samples/egg from different regions, to avoid the lack of uniformity (Commissione Metodologie di Valutazione delle Produzioni delle Piccole Specie, 1996).

Raw data were elaborated according to the least squares method using a model of variance analysis (fixed factor: breed or type of egg) (SAS, 2004).

Results and discussion

The curve of egg production of MOD and ROM hens is represented in figure 1. The first oviposition occurred at about 32 weeks of age in both breeds. This age is strongly delayed if compared to commercial strains of hens in battery cages, that show the start of oviposition at about 20 weeks of age; the difference should be imputed to the genetic effect, rather than to housing system. As reported by Van den Brand et al. (2004), within the same breed, the delay of first oviposition due to housing system is about 3 weeks.

Both MOD and ROM breeds are traditionally considered as laying breeds, because they are morphologically light, but a selection toward egg production was never conducted in the past; so the performance is not comparable to that from commercial breeds selected for egg production. Total egg production was about 100 egg/hen and was, on average, higher in MOD than in ROM (+5.9%). The figure highlights the differences in egg production observed in relation to the season: as in spring ROM hens showed a better egg production than MOD hens, from June to late Summer MOD hens revealed a better performance.
Weights and measures of eggs produced by the two local breeds and those obtained by samples of white and brown commercial eggs are reported in table 1.

Table 1 Least squares means (±SE) of weights and measures of eggs

<table>
<thead>
<tr>
<th></th>
<th>MOD</th>
<th>ROM</th>
<th>Commercial white</th>
<th>Commercial brown</th>
<th>RSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (g)</td>
<td>53.73 ± 0.14</td>
<td>54.03 ± 0.14</td>
<td>60.26 ± 0.91</td>
<td>66.83 ± 1.29</td>
<td>5.48</td>
</tr>
<tr>
<td>Length (mm)</td>
<td>55.40 ± 0.06</td>
<td>55.71 ± 0.06</td>
<td>57.64 ± 0.38</td>
<td>62.33 ± 0.54</td>
<td>2.27</td>
</tr>
<tr>
<td>Max breadth (mm)</td>
<td>41.86 ± 0.05</td>
<td>41.76 ± 0.05</td>
<td>43.61 ± 0.29</td>
<td>43.00 ± 0.41</td>
<td>1.76</td>
</tr>
<tr>
<td>Shape index</td>
<td>75.61 ± 0.08</td>
<td>75.01 ± 0.09</td>
<td>75.69 ± 0.52</td>
<td>69.02 ± 0.74</td>
<td>3.12</td>
</tr>
</tbody>
</table>

a,b,c,d: P<0.05

The comparison between eggs from local breed and commercial eggs from intensive production systems is purely indicative, and does not imply any kind of conclusion: in fact the majority of genetic and environmental factors affecting egg characteristics are not taken into account. Eggs produced by the local breeds were significantly (P<0.05) lighter and smaller than commercial, as the shape was similar to commercial white eggs, probably due to a common genetic origin (white ear-lobed strains). MOD eggs were significantly (P<0.05) shorter (-0.54%) than ROM; the shape index indicates that MOD eggs were slightly but significantly more rounded than ROM, and, as a consequence, probably more resistant (Bain, 1991).

Shell color parameters are reported in table 2.

Table 2 Least squares means (±SE) of eggshell colour parameters

<table>
<thead>
<tr>
<th></th>
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<th>Commercial brown</th>
<th>RSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>L*</td>
<td>91.39 ± 0.07</td>
<td>92.42 ± 0.08</td>
<td>94.69 ± 0.35</td>
<td>68.99 ± 0.49</td>
<td>2.07</td>
</tr>
<tr>
<td>a*</td>
<td>0.29 ± 0.03</td>
<td>0.43 ± 0.03</td>
<td>-0.56 ± 0.15</td>
<td>12.79 ± 0.21</td>
<td>0.89</td>
</tr>
<tr>
<td>b*</td>
<td>7.25 ± 0.12</td>
<td>6.26 ± 0.12</td>
<td>2.69 ± 0.56</td>
<td>25.80 ± 0.80</td>
<td>3.38</td>
</tr>
<tr>
<td>Hue</td>
<td>0.51 ± 0.05</td>
<td>0.77 ± 0.05</td>
<td>-1.33 ± 0.21</td>
<td>1.12 ± 0.29</td>
<td>1.24</td>
</tr>
<tr>
<td>Chrome</td>
<td>7.32 ± 0.12</td>
<td>6.33 ± 0.12</td>
<td>2.76 ± 0.56</td>
<td>28.87 ± 0.80</td>
<td>3.37</td>
</tr>
</tbody>
</table>

a,b,c,d: P<0.05

The results show significant differences among the eggs from the two local breeds and those from the commercial strains: L*, a* and b* parameters resulted intermediate between commercial white and brown eggs, but in absolute more similar to the first. Differences between MOD and ROM eggs indicated higher lightness and redness and lower yellowness and chrome (P<0.05) in ROM eggs than in MOD, probably due to a lower pigment mobilization, as confirmed by the results of a study about colour parameters of breast meat (Sabbioni et al., 2006).

The incidence of the different egg components (shell, yolk, albumen) is reported in table 3.

Table 3 Least squares means (±SE) of the incidence of eggshell, yolk and albumen and of eggshell thickness

<table>
<thead>
<tr>
<th></th>
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<th>Commercial brown</th>
<th>RSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggshell (%)</td>
<td>12.88 ± 0.19</td>
<td>13.29 ± 0.19</td>
<td>12.78 ± 0.41</td>
<td>11.84 ± 0.26</td>
<td>1.00</td>
</tr>
<tr>
<td>Yolk (%)</td>
<td>34.96 ± 0.32</td>
<td>32.35 ± 0.31</td>
<td>30.80 ± 0.68</td>
<td>26.21 ± 0.43</td>
<td>1.66</td>
</tr>
<tr>
<td>Albumen (%)</td>
<td>49.35 ± 0.54</td>
<td>52.59 ± 0.52</td>
<td>55.40 ± 1.14</td>
<td>60.09 ± 0.72</td>
<td>2.80</td>
</tr>
<tr>
<td>Eggshell thickness (mm)</td>
<td>0.337 ± 0.006</td>
<td>0.369 ± 0.006</td>
<td>-</td>
<td>-</td>
<td>0.032</td>
</tr>
</tbody>
</table>

a,b,c,d: P<0.05
Eggs produced by commercial strains have a significantly (P<0.05) lower incidence of yolk and a significantly (P<0.05) higher incidence of albumen than those from local breeds. Yolk/albumen ratio ranged between 43.6% and 55.6% in commercial eggs and between 61.5% and 70.8% in local breeds and was in agreement with the data reported by Van den Brand et al. (2004). Commercial brown eggs showed a lower incidence of eggshell than those from local breeds (P<0.05). MOD eggs showed a lower albumen incidence and a higher yolk incidence (P<0.05), as percent of total egg weight, than ROM eggs. Eggshell incidence was not significantly different (P>0.05) between the two local breeds, but shell thickness was lower in MOD eggs (-8.1%; P<0.05) than in ROM.

The chemical composition of egg components is reported in table 4.

Table 4 Least squares means (±SE) of the chemical composition of yolk and albumen.

<table>
<thead>
<tr>
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<th>RSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yolk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- moisture (%)</td>
<td>51.88 ± 1.46</td>
<td>50.59 ± 1.46</td>
<td>50.08 ± 2.07</td>
<td>50.42 ± 1.46</td>
<td>3.59</td>
</tr>
<tr>
<td>- ash (%)</td>
<td>3.00 ± 0.11</td>
<td>2.33 ± 0.11</td>
<td>1.85 ± 0.16</td>
<td>2.86 ± 0.12</td>
<td>0.27</td>
</tr>
<tr>
<td>- crude protein (%)</td>
<td>15.61 b ± 0.21</td>
<td>16.10 b ± 0.21</td>
<td>14.78 a ± 0.30</td>
<td>15.21 a ± 0.21</td>
<td>0.52</td>
</tr>
<tr>
<td>- ether extract (%)</td>
<td>27.33 a ± 0.36</td>
<td>26.99 a ± 0.36</td>
<td>29.14 b ± 0.52</td>
<td>28.05 b ± 0.36</td>
<td>0.89</td>
</tr>
<tr>
<td>Albumen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- moisture (%)</td>
<td>88.27 ± 0.38</td>
<td>87.44 ± 0.38</td>
<td>87.74 ± 0.53</td>
<td>87.96 ± 0.38</td>
<td>0.92</td>
</tr>
<tr>
<td>- ash (%)</td>
<td>1.12 ab ± 0.18</td>
<td>0.72 a ± 0.18</td>
<td>0.76 a ± 0.26</td>
<td>1.53 b ± 0.18</td>
<td>0.44</td>
</tr>
<tr>
<td>- crude protein (%)</td>
<td>9.85 b ± 0.27</td>
<td>10.29 bc ± 0.27</td>
<td>11.02 c ± 0.38</td>
<td>8.68 a ± 0.27</td>
<td>0.65</td>
</tr>
</tbody>
</table>

a,b,c: P<0.05

The results showed little differences between the two local breeds and commercial strains with reference to moisture content of yolk and albumen. Eggs from local breeds showed higher contents of yolk protein than commercial eggs (P<0.05). Differences between MOD and ROM were very slight and became significant (P<0.05) only for ash content of yolk.

In conclusion it is possible to affirm that Modenese and Romagnolo hens from Emilia-Romagna region of Italy have shown a low egg production, if compared to commercial strains. A total egg production of about 100 eggs/hen could be rather of interest in the conditions of outdoor rearing or organic farming. The characteristics of eggs from MOD and ROM breeds are very different from those of commercial strains: in local breeds we observed smaller eggs with higher incidence of yolk. Further research is necessary to evaluate factors affecting egg production in the outdoor farming systems and to determine the content of other egg components.

References


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