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PAPER

Breeding performance in the Italian chicken breed *Mericanel della Brianza*

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Abstract

In Italy, 90 local avian breeds were described; the majority (61%) were classified as extinct and only 8.9% as still widely spread. Therefore, efforts for conservation of Italian avian breeds are urgently required. The aim of this study was to record the breeding performance of the Italian breed *Mericanel della Brianza* to multiply a small population, in order to develop a conservation programme. Fourteen females and eight males were available at the beginning of the reproductive season in 2009 and organised into eight families (1 male/1-2 females) kept in floor pens. Birds received a photoperiod of 14L:10D and were fed *ad libitum*. Breeding performance was recorded from March to June. Egg production and egg weight were recorded daily; eggs were set every two weeks and fertility, embryo mortality and hatchability were recorded. Mean egg production was 37% and mean egg weight was 34±3.49 g. High fertility values from 94% to 87% were recorded in the first three settings and the overall mean fertility value was 81.6%. Overall hatchability was only 49.6% owing to a high proportion of dead embryos. Embryo mortality occurred mainly between days 2 and 7 of incubation and during hatching. The highest hatchability values were recorded in settings 1 and 2, 69% and 60% respectively, and a large decrease was found in the subsequent settings. Marked variations in egg production, fertility, hatchability and embryo mortality were found among families. The present results represent the basic knowledge of reproductive parameters necessary to improve the reproductive efficiency of the breed within a conservation plan.

Introduction

Italy had a wide diversity of animal breeds and populations consolidated over the centuries and promoted by a very large environmental variety. However, animal biodiversity has been threatened in the past few decades and is in constant decline because of the changes occurring in the modern animal production system. Rural areas have decreased, modern animal production systems are highly intensified and standardised, highly productive breeds are globally diffused and preferred to local breeds. Such a situation is greatly emphasised in the poultry sector where only selected strains are reared for meat and egg production and local breeds have been excluded from the intensive productive system. The need for conservation of avian genetic resources is well recognised and actions are requested from both public and private institutions (Delany and Pisenti, 1998; Blackburn, 2004, 2006; Fulton, 2006). Local chicken breeds are a vital reservoir of gene resources and their conservation has a technical role related to the future development of the productive system, as well as a social-cultural role.

According to the inventory done by Zanon and Sabbioni in 2001, the consistency of Italian avian breeds is dramatically decreased today. In addition, the high inbreeding level reached in each breed causes a progressive reduction of productive features, such as live body weight (Zanon and Sabbioni, 2001). According to a wide literature search, 90 Italian avian breeds were described, classified and dated from the last century. The majority of the breeds (61%) were classified as extinct, 13% as threatened, 17% as poorly diffused and only 8.9% as still widely spread (Zanon and Sabbioni, 2001). It is clear that efforts for conservation of Italian avian breeds are urgently required. The risk of losing avian genetic resources related to particular Italian areas is real and it is fundamental to promote and support conservation programmes.

Two conservation strategies are generally suggested for at-risk populations: *in situ* or conservation of a living population in their native habitat and *ex situ* or conservation of genetic material or living individuals outside of their native habitat (i.e. zoo, natural parks, experimental farms). The *in situ* strategy allows conservation of diversity in its evolutionary dynamic (Pagnacco, 1997) and is considered the most important.

Inbreeding is the first problem in conservation plans applied to populations of small size.

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Inbreeding reduces genetic variability and adaptation ability to the surrounding environment. It has a depressive effect on some productive and reproductive traits with low hereditability and is responsible for the inevitable genetic drift. The development of a conservation programme includes different activities: improvement of the knowledge of biological functions, conservation of typical morphological characteristics, development of selection strategies, control of inbreeding and, finally, valorisation strategies to diffuse the breed in local productive systems (Zanon and Sabbioni, 2001). As regards Italian avian breeds, few conservation programmes have been completed or are in progress with the support of local institutions. In particular, the *Veneto* (Baruchello and Cassandro, 2003) and *Emilia Romagna* (Zanon *et al*. 2006; Sabbioni *et al*., 2006) avian breeds, *Valdarnese bianca* (Gualtieri *et al*., 2006), *Livorno* and *Ancona* (*www.polloderba.it*) breeds have been considered for conservation.

The aim of the present work was to study the breeding performance of the Italian chicken breed *Mericanel della Brianza* in order to set up a conservation programme. A small population acquired by the VSA Department (University of Milan) was multiplied during the reproductive season in 2009 and the breeding data registered.

Materials and methods

Description of the *Mericanel della Brianza* breed

Mericanel della Brianza (MB) is an Italian bantam poultry breed, historically present in the rural areas of the Lombardia region (North Italy). It is the only Italian bantam breed with an official standard (F.I.A.V., 1996) and is still present in the country hills north of Milan. It is assumed that the breed originated from rural free-range bantam chickens at the beginning of the last century. It was popular for its brooding behaviour and largely used to hatch game bird chickens or other chickens from non-brooding breeds. MB is a fine-looking bantam chicken with a round and well-proportioned shape. With a lively temperament and strong-natured, it does not like to be restricted in a small room. MB is characterised by a cylindrical trunk and simple straight red comb with the back lobe coming off flatly from the nape. In the hen, the comb can be curved on one side without covering the eye, but often is straight. The legs have yellow skin with a naked tarsus. The mean body weight is 750 g and 650 g for adult males and females, respectively. Several plumage colours are considered standard in the breed and the most common are the golden and the yellow black-tailed. The egg shell is cream or brown and egg weight is around 35 g.

Protocol on reproductive performance

MB females (n=14) and males (n=8) were available at the beginning of the reproductive season in 2009 and housed in a controlled environment at the Poultry Unit, Animal Production Centre, University of Milan (Lodi). All birds had white plumage and were acquired in a few reproductive seasons from a local fancy breeder. Eight families (1 male/1-2 females) were made up and kept in floor pens (1×3 m) under natural mating conditions. Birds received a photoperiod of 14L:10D and were fed a standard commercial diet for chicken breeders *ad libitum*. Data were recorded for 11 weeks from March to June. Egg production and egg weight were recorded daily in each pen; eggs were stored at 18°C in an isolation room and set every two weeks. In total, six egg settings were performed. Fertility and early embryo mortality were recorded on the seventh day of incubation by candling. Hatchability was recorded and eggs not hatched were opened to record late embryo mortality. Embryo mortality was classified into five categories: 0-48 h, 3-7 days, 8-14 days, 15-20 days, at hatching.

Egg production was calculated per week. Descriptive statistical parameters were calculated for egg weight. Analysis of variance was performed for egg weight and the week of oviposition considered as a source of variation (SAS, 1999). Data on fertility, embryo mortality and hatchability were analysed using the χ^2 test to determine results diverging from the null hypothesis; setting and family were considered as frequency categories (SAS, 1999).

Results

Mean egg production recorded weekly during the reproductive period is reported in Figure 1. Egg production was very variable from weeks 1 to 9 and ranged from 48% to 29%; egg laying progressively decreased in the last 2 weeks to 19% (Figure 1). In total, 392 eggs were laid in 11 weeks by 14 females, only 6 were discarded and 387 set.

The mean egg weight was 34±3.49 g, and a large range of variation from 23 g to 45 g was recorded (coefficient of variation: 10.3%). However, the mean egg weight was constant and no significant differences were recorded between weeks during the reproductive period. Six subsequent settings were performed from 30th March to 1st June. High fertility values from 94% to 87% were recorded in the first three settings, and the overall mean fertility value was 81.6% (Figure 2). The χ^2 calculated from the frequency of fertile (Figure 2) and hatched eggs and from the frequency of dead embryos (Figure 3) per each setting showed significant differences (P<0.001).

The number of fertile eggs recorded in setting 1 was significantly higher compared to the expected values and, in contrast, the number of fertile eggs recorded in setting 4 was significantly lower. The best breeding period can be identified with settings 1, 2 and 3 and a decrease occurred in the subsequent settings (Figure 2). High hatchability and low embryo mortality were recorded in settings 1 and 2 and, in contrast, the opposite trend was recorded in the subsequent settings (Figure 3).

Large variations in fertility, hatchability and embryo mortality were found among families (FAM). The χ^2 calculated from the frequency of fertile (Figure 4) and hatched eggs and from the frequency of dead embryos (Figure 5) per each family showed significant differences (P<0.001). The proportion of fertile eggs recorded in FAM 2 and 4 was significantly higher than the expected values and, in contrast, the proportion of fertile eggs recorded in FAM 6, 7 and 8 was significantly lower. High proportions of fertile eggs were also recorded in FAM 1, 3 and 5, even if sig-

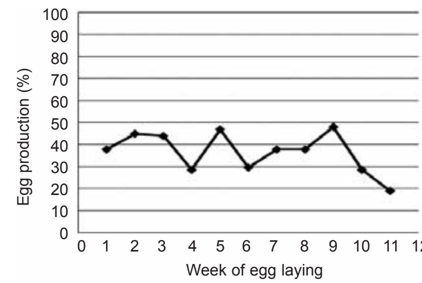

Figure 1. Egg production recorded weekly from March to June.

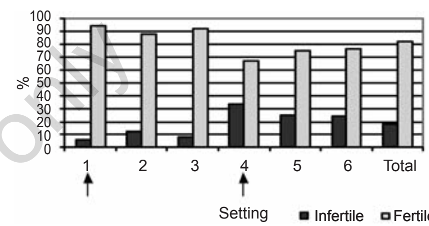

Figure 2. Proportions of fertile and infertile eggs calculated per each setting. Arrows show a significant difference between recorded and expected values (χ^2 test, P<0.001).

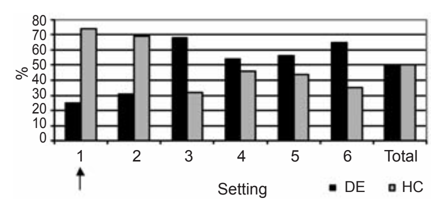

Figure 3. Proportions of dead embryos and hatched chicks calculated from fertile eggs per each setting. Arrow shows a significant difference between recorded and expected values (χ^2 test, P<0.001). DE, dead embryos; HC, hatched chicks.

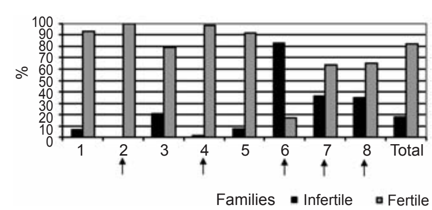

Figure 4. Proportions of fertile and infertile eggs calculated per each family. Arrows show a significant difference between recorded and expected values. (χ^2 test, P<0.001).

nificant differences were not found.

High hatchability and low embryo mortality were recorded in FAM 2, 4 and 7; however, a significant difference between recorded and expected values was found only in FAM 4 (P<0.001). In contrast, hatchability recorded in FAM 1 and 8 was significantly lower than the expected values. FAM 6 showed 100% of dead embryos, but the result was not significant because of the low number of eggs (Figure 5).

The best reproductive performance was recorded in FAM 2: 100% fertility; 73.5% hatchability and 26.4% embryo mortality. On the other hand, the worst reproductive performance was recorded in FAM 6: 16.7% fertility; 0% hatchability; 100% embryo mortality. Embryo mortality was classified into five categories and the relative distribution is reported in Figure 6. Embryo mortality occurred mainly between day 3 and 7 of incubation (category B), from day 19 to 20 (category D) and during hatching (category E). In total, 151 live chickens hatched from 304 fertile eggs, corresponding to 49.6% hatchability.

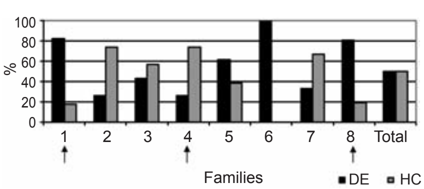

Figure 5. Proportions of dead embryos and hatched chicks calculated on fertile eggs for each family. Arrows show a significant difference between recorded and expected values (χ^2 test, P<0.001). DE, dead embryos; HC, hatched chicks.

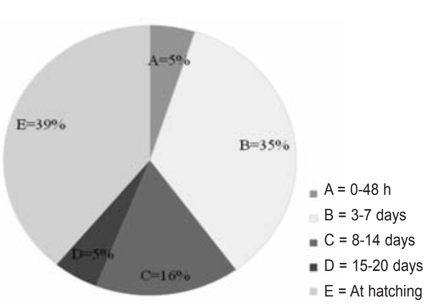

Figure 6. Distribution into five categories (A-E) of embryo mortality recorded during artificial incubation of *Mericanel della Brianza* eggs.

Discussion

The world databank of FAO for genetic resources of farm animals reports that more than 2000 domestic breeds could disappear in the next 20 years and an inestimable diversity would disappear with them. When a breed is extinct, it is forever. It is necessary to preserve local breeds in order to allow the breeder to use them as biodiversity "capital", and is useful to create new breeds in response to environmental changes, diseases and changes in consumer demand. Efforts for conservation of Italian avian breeds are urgently required because only 8.9% of the 90 breeds reported in the inventory done by Zanon and Sabbioni in 2001 are still not at risk.

Original data on the reproductive performance of the Italian bantam breed, *Mericanel della Brianza*, are reported here for the first time. The data were collected during a reproductive season, from March to June, and will be fundamental in selecting breeders within a conservation plan.

Egg production was largely variable during the reproductive period, even if birds were kept in a controlled environment. Each female laid an average of 28 eggs in an 11-week period. According to their body size, MB females lay small eggs and the mean egg weight was 34 g. *Pepoi* is an Italian bantam breed from the Veneto region; females have a body weight of 1.0-1.1 kg, slightly heavier than MB hens, and egg weight is also higher, corresponding to 40-45 g (De Marchi *et al*., 2005).

The mean fertility recorded during the whole reproductive period was 81.6% and the highest values were recorded in the first weeks of oviposition. Similar fertility data were recorded in poultry strains and other breeds; for instance, 77.5%-97.4% in the *Cobb* strain (Pedroso *et al*., 2005) and 89.9%-93.5% and 91.6%-95.4% in the *Tibetan* and *Dwarf* bantam breeds, respectively (Zhang *et al*., 2008). The best fertility values were recorded in March and this could be the month with the major reproductive efficiency of this breed. Mean hatchability was 49.6% versus 71.8%-84.9% in Cobb, 71.3%-86.4% in *Tibetan* and 31.6-86.1% in *Dwarf* breeds. Hatchability was higher in the first two settings, corresponding to 71.5%, in accordance with the highest fertility values.

Very large variability in breeding performance was found among families and extreme situations were recorded. Selection of the breeders is a key factor in a conservation plan in order to assure a successful breeding performance. The present results underline the importance in studying the variability of reproductive parameters among breeders in order to identify and select the best breeders or, at least, discard the worst.

The highest embryo mortality was recorded in the first seven days of incubation and on hatching, according to the results reported in *Cobb* breeders (Pedroso *et al*., 2005) and *Tibetan* and *Dwarf* breeds (Zhang *et al*., 2008). Our data confirm that the first 6-7 days of incubation and the hatching period are the most critical periods for the survival of chicken embryos.

Embryo mortality occurs more frequently at the early stage (North and Bell, 1990; Deeming, 2000) and indicates a greater sensitivity of the embryo to metabolic disorders and genetic deviations at the initial stages of its development (Bloom and Muscarella, 1998). Additionally, it has been reported that embryos that die after *pipping* of the internal and external membranes may have been exposed to inadequate temperature and moisture situations during the incubation process (North and Bell, 1990). *Mericanel* eggs are characterised by a small size, a low proportion of albumen and a high proportion of shell (Zaniboni *et al*., 2006) compared to the size and composition of eggs from standard laying hens. Standard environmental parameters recommended for the incubation of chicken eggs might be unsuitable for such peculiar eggs and variations in temperature and moisture situations could be further studied to improve hatchability.

Conclusions

Conservation of the *Mericanel della Brianza* chicken breed contributes to the wider general action of conservation of Italian avian genetic resources. Genetic, reproductive and productive parameters should be known in order to programme objective conservation plans based on scientific data. The present results represent the basic knowledge of reproductive parameters necessary to improve the reproductive efficiency of the conserved breed. Conservation of avian breeds plays an important role in safeguarding of animal biodiversity; it could have a relevant role in developing new high quality products for niche markets and also represents an important tool to preserve and support the rural economy in some marginal agricultural areas.

References

Baruchello, M., Cassandro, M., 2003. Avicoli Veneti. In: Veneto Agricoltura, Settore Ricerca e Sperimentazione Agraria e Ittica (ed.) Progetto CO.VA. - Interventi per la conservazione e la valorizzazione di razze avicole locali venete. Home page address: http//www.venetoagricoltura.org.

Blackburn, H.D., 2004. Development of national animal genetic resource programs. Reprod. Fert. Devel. 16:27-32.

Blackburn, H.D., 2006. The national animal germplasm program: challenges and opportunities for poultry genetic resources. Poultry Sci. 85:210-215.

Bloom, S.E., Muscarella, D.E., 1998. Stress response in the avian early embryo: regulation by pro- and anti-apoptotic cell-death genes. Avian Poult. Biol. Rev. 9:43-55.

Deeming, D.C., 2000. Principles of artificial incubation for game birds – A practical guide. Oxford Print Centre, Oxford, UK.

Delany, M.E., Pisenti, J.M., 1998. Conservation of poultry genetic research resources: consideration of the past, present and future. Avian Poult. Biol. Rev. 9:25-42.

De Marchi, M., Cassandro, M., Targhetta, C., Baruchello, M., Notter, D.R., 2005. Conservation of poultry genetic resource in the Veneto region of Italy. AGRI 37:63-74.

FIAV, 1996. Standard Italiano delle Razze avicole. Tipografia Artigiana, Casatenovo, Lecco, Italy.

Fulton, J.E., 2006. Avian genetic stock preservation: an industry perspective. Poultry Sci. 85:227-231.

Gualtieri, M., Pignatelli, P., Cristalli, A., 2006. Pollo di razza Valdarnese bianca. In: Commissione tecnico-scientifica ARSIA (ed.) Risorse genetiche animali autoctone della Toscana. Stampa Press Service s.r.l., Sesto Fiorentino, Italy, pp 37-45.

North, M.O., Bell, D.D., 1990. Commercial chicken production manual. 4th ed. AVI Book Press, NY, USA.

Pagnacco, G., 1997. Genetica applicata alle produzioni animali. Città Studi Edizioni, Milano, Italy.

Pedroso, A.A., Andrade, M.A., Café, M.B., Leandro, N.S., Menten, J.F., Stringhini, J.H., 2005. Fertility and hatchability of eggs laid in the pullet-to-breeder transition period and in the initial production period. Anim. Reprod. Sci. 90:355-364.

Sabbioni, A., Zanon, A., Beretti, V., Superchi, P., Zambini, E.M., 2006. Carcass yield and meat quality parameters of two Italian autochthonous chicken breeds reared outdoor: Modenese and Romagnolo. World Poultry Sci. J. 62(Suppl):203 (Abstr.).

SAS, 1999. User's guide. Version 8. Cary, NC, USA.

Zaniboni, L., Mangiagalli, M.G., Tona, S., Cerolini, S., 2006. Reproductive parameters of the Italian local chicken breed Mericanel della Brianza. World Poultry Sci. J. 62(Suppl):535 (Abstr.).

Zanon, A., Sabbioni, A., 2001. Identificazione e salvaguardia genetica delle razze avicole Italiane. In: Università degli Studi di Parma (ed.) Annali Facoltà di Medicina Veterinaria, Parma, Italy, vol. XXI, pp 117-134.

Zanon, A., Beretti, V., Superchi, P., Zambini, E.M., Sabbioni, A., 2006. Physico-chemical characteristics of eggs from two Italian autochthonous chicken breeds: Modenese and Romagnolo. World Poultry Sci. J. 62 (Suppl):203 (Abstr.).

Zhang, H., Wang, X.T., Chamba, Y., Ling, Y., Wu, C.X., 2008. Influences of hypoxia on hatching performance in chickens with different genetic adaptations to high altitude. Poultry Sci. 87:2112-2116.