Productive performance and carcass traits of Leghorn chickens and their crosses reared according to the organic farming system

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The organic farming system needs poultry breeds adapted to greater space availability, poor environmental conditions and contemporarily able to provide satisfactory productive performance. To this aim, the productive performance and carcass traits of Leghorn chickens and their crosses with a French female line (Sasso SA51) reared under organic farming conditions (10 m^2/bird) were compared. Four homogeneous groups of 250 chickens (male and female), fed the same diet, were reared until 120 days of age. Individual body weights were recorded weekly, as well as the collective feed intake of each group. Feed:gain ratio was calculated from the average feed consumption of the group; the slaughter weight and mortality rate were also recorded. After slaughter, 25 carcasses per group were plucked, eviscerated (non-edible viscera: intestines, proventriculus, bladder, spleen, esophagus and full crop) and stored for 24 hours at + 4 °C. Head, neck, legs, edible viscera (heart, liver, gizzard), and depot fat were removed in order to obtain the ready-to-cook carcass, dressing out percentage and carcass characteristics (breast and drumstick percentage). Productive performance was greatly affected by sex and genotype. The best productive performance was observed in cross-bred males (3.4 feed conversion index and 2.42 kg of slaughter weight; P<0.01), whereas the worst was observed in the pure-bred females group (4.8 feed conversion index and 1.48 kg of slaughter weight). No significant difference was found between male Leghorns and cross-bred females. Mortality rate was not affected by genotype (about 7%). Cross-bred male chickens had the higher carcass weight (1.82 kg; P<0.01), while the dressing out percentage was not affected by gender and genotype. Leghorn chickens showed the lowest fat depot (0.9 % of ready-to-cook carcass, P<0.01). The carcass characteristics were not greatly affected by gender; the drumstick and breast yield percentage was significantly (P<0.01) higher in cross-bred (14.2 vs 11.6 % of ready-to-cook carcass). Further investigations are necessary to better assess the adaptability of the cross-bred chickens to the organic system with the different seasons and environment.

Keywords: chickens, organic production, productive performance, carcass characteristics

INTRODUCTION

The primary aim of the organic production system is optimising ecological production that promotes biodiversity, environmental sustainability and food safety. However, for animal production, recommendations and compulsory rules provided by the REG 1809/99 do not give the expected results in poultry production (Castellini, 2005) in term of animal welfare and qualitative characteristics of the products. In organic poultry production the most important factors affecting meat characteristics are the older slaughter age and the physical activity of the birds. Such factors are greatly modulated by the genetic strain: comparison of slow-growing strains with fast-growing strains

shows many behavioural differences mainly in the motor activity of the chickens and in the use of external paddocks (Lewis *et al.*, 1997). Fast-growing animals are not adapted to the organic system and health and welfare problems are recurrent, but economic reasons and limited chick availability render these animals widely used in organic poultry production (Network for Animal Health and Welfare in Organic Agriculture, 2002). Selection for high production rates modifies animal behaviour (Schütz and Jensen, 2001) reducing all the activities involving high energetic costs and reallocating the saved energy to production traits.

Fast growing birds do not perform well under poor environmental conditions, whereas intensive rearing provides them with what is needed to cover all of their physiological needs (Reiter and Bessei, 1996). On the contrary, S genotype shows a superior degree of adaptation but the performance is very poor. So, the choice of a genotype requires attaining a balance between rusticity and productive performance.

The objective of this work was to compare the growing performance and carcass traits of a slow-growing chicken strain (Leghorn) pure or crossed with a heavy strain under the organic system.

Material and methods

Animals, housing and feeding

One thousand 1-day-old chicks of both sexes from a slow-growing breed (Golden Leghorn) and their crosses with Sasso (SA51), that is a French genotype used for Label Rouge, were reared separately (n=300 per sex and genotype) on the experimental farm of the Animal Production Department (University of Perugia). Chicks were vaccinated against Marek and Newcastle disease and coccidiosis (Paracox®-8). The birds of each group were put in covered shelters with 2 repetions/group with straw litter and access to a grass paddock (10 m^2/bird).

Chickens were fed *ad libitum* the same standard starter (1-21 d) and finisher (22 d to slaughter) diets containing more than 80% certified organic ingredients by a national agency. The main chemical characteristics (% d.m.) of the finisher diet were the following: crude protein 18.05, ether extract, 4.98 crude fibre 4.01 ME 12.9 MJ/kg. Individual body weights were recorded weekly, and the collective feed intake of each sub-group was recorded. The average feed consumption of the group was used to calculate the feed:gain ratio.

At 120 days, a sample of 50 birds per strain (25 males and 25 females), each weighing between ± 10% of the population mean, were slaughtered, 12 hours after feed withdrawal in the Department processing plant. Chickens were not transported and were electrically stunned (110 V; 350 Hz) before killing.

Carcass dissection

After killing, carcasses were plucked, eviscerated (non-edible viscera: intestines, proventriculus, gall bladder, spleen, oesophagus and full crop) and stored for 24 hours at + 4 °C. Head, neck, legs, edible viscera (heart, liver, gizzard) and fat (perivisceral, perineal and abdominal) were removed in order to obtain the ready-to-cook carcass (ASPA, 1996). Breast conformation was measured as follows: the maximal breast width and length were measured with a callipers, whereas the thickness was evaluated by inserting a metal needle in the fourth anterior of the sternum.

Statistical analyses

Data were analysed with a linear model (STATA, 2005) and the significance of differences was evaluated by t-test. The productive performance and carcass data, the sex effect and interaction were also included in the model. Mortality rates were evaluated by the X^2.

Results and discussion

Throughout the experiment, the body weights of the two genotypes were markedly different in the two sexes, and these differences increased with the age of the birds (*Table 1*). As expected, the productive performance of the crossed birds was much higher than that of pure Leghorn. At 120 days

of age, the male crossed birds reached their highest body weights with a satisfactory feed/gain ratio (3.4). The mortality rate of all the birds was very low considering the long rearing age of the animals.

Table 1. Performance of birds.

Strain		Pure		Cross		P		Root MSE
Sex		F	M	F	M	Sex	Strain	
Live weight	g	1480	1865	1970	2420	**	**	202
Feed intake	g/d	58	68	61	69	n.s.	**	6
Daily gain	"	12.4	15.6	16.5	20.1	**	**	2.2
Feed to gain ratio		4.8	4.4	3.8	3.4	n.s.	**	0.4
Mortality (1)	%	6.3	8.0	6.5	7.8	n.s.	n.s.	

n.s : not significant; * P<0.05; ** P<0.01; (1) X^2

The body weight of pure Leghorn was less than 2 kg, which is under the minimum marketable weight for poultry products (Saveur, 1997), and they had a higher (P<0.01) feed/gain ratio than the crossed birds.

The carcass weight and the ready-to-cook carcass was significantly lower (P<0.01) in pure birds than in the crossed chicks; male chickens were heavier than females (P<0.01).

All the carcasses were very lean and the abdominal fat was very low in all the birds confirming that even at an older age slow-growing genotypes due to great locomotory activity and pasture aptitude continued to show low fat deposition (Castellini *et al.,* 2006).

The proportion of breast was greater in crossed birds than in pure ones (P<0.01) and also the conformation changed (higher width and thickness with quite the same length); on the contrary the thigh and drumstick percentages were the same in all the groups.

Table 2. Carcass characteristics of birds.

Strain		Pure		Cross		P		Root MSE
Sex		F	M	F	M	Sex	Strain	
Carcass weight	g	1130	1520	1503	1820	*	**	192
Ready-to-cook-carcass (R.C.)	"	954	1190	1283	1567	**	**	185
Ready-to-cook-carcass	% live weight	64.0	63.8	64.7	64.6	n.s.	*	6.0
Gastrointestinal tract	"	10.0	10.0	9.8	9.7	n.s.	*	1.0
Abdominal fat	"	0.9	0.9	1.1	1.0	n.s.	**	0.1
Breast meat yield	% RC	11.5	11.8	14.3	14.1	n.s.	**	4.5
Breast width	cm	4.2	4.7	5.8	6.2	n.s.	**	0.9
Breast layer thickness	"	1.7	1.8	2.0	2.1	n.s.	*	0.2
Breast bone length	"	10.8	11.2	10.8	11.1	n.s.	n.s.	1.7
Thigh	% RC	16.2	16.0	16.2	16.5	n.s.	*	1.8
Drumstick	"	15.0	15.2	16.0	16.0	n.s.	*	2.0

n.s : not significant; * P<0.05; ** P<0.01

The experiment showed that the productive performance and the carcass traits of a very slow-growing strain could be improved by crossing such birds with a more productive one. However such improvements (highest breast percentage) did not limit the kinetic activity of the birds (data not shown) which remained very high.

The recommendations of the Network for Animal Health and Welfare in Organic Agriculture (2002) suggest that to reduce welfare problems the use of commercial breeds should be avoided, unless they have been tested and shown to work under organic conditions. Chickens with a slow growing rate express more "natural" behavioural patterns, and should be used for extensive production systems. However, strains with excessively low growth rates require a very long rearing time (until 100-120 d – Castellini *et al*., 2006), resulting in high production costs.

With this background, the position of slow-growing strains as an organic product could be strengthened if future research shows their ability to perform with feed of lower quality, and to produce meat with well-differentiated qualitative characteristics. Organic poultry production in the last years had not attained the expected increase in consumption; in our opinion further gain could be obtained only if the qualitative traits of organic meat are easily perceived and discriminated by the consumer.

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