Slaughter performance and meat quality of Milanino chickens reared according to a specific free-range program

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ABSTRACT The study aimed to characterize meat quality traits of Milanino chickens reared according to a specific free-range farming program. A total of 120 birds was reared straight-run in outdoor pens (8 m^2/bird) from 35 d of life and fed ad libitum a low (16%) protein diet. At 180 d of age, 20 birds (10 birds/sex) were slaughtered, and carcass weight data were recorded. After processing, carcasses were refrigerated at 4°C for 24 hours. Then, the right breast and thigh with skin were collected and color parameters, pH, water-holding capacity (WHC), and chemical composition were determined. The left breast and thigh were stored at −20°C until cooking loss and tenderness evaluation. Milanino was confirmed to be a heavy breed with a sexual dimorphism in relation to adult body weight. A high general carcass yield was recorded. Milanino meat was characterized by high protein and low fat contents compared with the standard broiler meat. Differences in meat composition were recorded according to the sex: females presented higher values of dry matter (breast and thigh), protein (breast), and fat (breast and thigh) contents. The meat with skin presented an intense luminosity, and this trait was higher in the females. The muscle color was characterized by high redness and yellowness indices with differences according to the sex: Higher yellowness index was observed in female carcasses, while higher redness index was detected in male breast samples. The pH muscle values were similar to those reported in other autochthonous breeds. WHC values did not show variation between sexes. In contrast, cooking loss values recorded in thigh samples were lower in males compared to females. The degree of tenderness of Milanino meat was not affected by the sex. However, the potential loss of water and the toughness in Milanino meat were low compared to other local chicken breed meat. The present results support the breeding of Milanino chickens for meat production according to its specific straight-run free-range system.

Key words: autochthonous breed, Milanino chicken, free-range, carcass yield, meat quality

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INTRODUCTION

The Milanino is a composite chicken breed (Valdarnese x Orpington) selected mainly for meat production at the beginning of the 20th century in the rural area close to Milan in the North of Italy (Cerolini et al., 2012). The breed was included in a conservation research project on poultry autochthonous breeds present in the Lombardia region (CoVAL project n. 1723, funded by Regione Lombardia). Conservation projects of Italian poultry breeds have been regionally developing since the 1990s thanks to the financial support of local public institutions (i.e., regions, districts). Safeguarding poultry biodiversity is a key objective in every developed country, including Italy, which places on it cardinal importance. In effect, within the last hundred years, the number of endangered local Italian breeds has dramatically increased, leading to an irreversible loss of genetic resources (Zanon and Sabbioni, 2001). The reasons for this negative trend mainly lie in the fact that only a few chicken breeds are selected to maximize yields, and specialized crossbreeds are preferred for the various poultry production outputs (Bianchi et al., 2011).

Currently, the conservation of avian genetic resources is part of the institutional activity in many Italian universities, and public funds have been available to support research activities aimed to contrast the threat of extinction (Ozdemir et al., 2013). These projects were mainly based on in situ conservation strategy (FAO, 2009) and included the Italian chicken breeds from Lombardia (Cerolini et al., 2012), Veneto (De Marchi et al., 2005; Zanetti et al., 2010), and Emilia Romagna (Sabbioni et al., 2006) regions, and Valdarnese Bianca and Ancona breeds also (Ozdemir et al., 2013). The

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FAO (2009) has often emphasized that the recovery of the strong link among environment, farming, local breeds, and products has been the safest strategy for Animal Genetic Resources (**AnGR**) conservation in many populations. Several studies have emphasized that the sustainability of AnGR management activities relies upon, among other things, the concomitant participation of different stakeholders (Rewe et al., 2009; Lauvie et al., 2011; Wurzinger et al., 2011; Mueller et al., 2015). Those stakeholders include livestock keepers, generally associated with small-scale livestock production, individually or organized in associations or cooperatives (Leroy et al., 2017). The livestock keepers' involvement has great relevance in order to spread conservation programs for local poultry breeds in different countries; however, it requires the understanding of different aspects: productive and functional attributes of animals, quality of breed products, production systems, technical-cultural and environmental aspects, current marketing of breed products under farmers' control such as branding, distribution channels developed by breeders, and policies and legislation concerning local breeds (Hoffmann, 2009; FAO, 2010; Singh and Fotsa, 2011). In Italy, there are several local chicken breeds that showed interesting meat quality traits (e.g., color and flavor; De Marchi et al., 2006). The concept of meat quality is particularly complex; however it can be stated that poultry meat is of good quality if it fully meets consumer expectations. Modern consumers seek meat that is low in fat, tender, and with good color and aroma (Magdelaine et al., 2008; Loo et al., 2010). The identification of good carcass characteristics or peculiar qualitative meat traits could support the potential use of local chicken breeds in innovative small-scale farming systems.

The Milanino could represent an important genetic resource for the development of a local meat production system of potential interest for the multi-functional farms within the agricultural sector in the Lombardia region. Previous studies on the rearing and productive characteristics of Milanino chickens have been carried out to develop an extensive farming system for the Milanino meat production in order to involve local Italian livestock keepers. In particular, the age of transfer to outdoor pens (unpublished results), the bird density (Mosca et al., 2015) and the dietary protein level (Mosca et al., 2016) during the growing period, and the suitable age of slaughter (Mosca et al., 2015; Mosca et al., 2016) were studied. The result of these studies was the compiling of management guidelines on an outdoor free-range system specific for the Milanino chicken breed. However, the quality of meat was only partially documented, and new data were needed to characterize Milanino meat quality in order to support its promotion in the market according to consumer expectations. The objective of this research was to collect new data about slaughter performance and describe qualitative meat traits of the Milanino chicken breed reared according to its specific farming program.

MATERIAL AND METHODS

Birds and Rearing System

The study was carried out during the 2015 reproductive season, from April to October. One-hundred-twenty Milanino chickens (62M:58F) were hatched at the Poultry Unit, Animal Production Center, University of Milan (Lodi). The chicks were reared straight-run in a controlled environment from 1 to 35 d of age following standard management guidelines for chickens. At hatch, birds were labeled with a metal wing tag, weighed, and vaccinated for Marek's and Newcastle diseases. On d 21, birds were weighed and provided with a second vaccination for Newcastle disease. Birds were fed ad libitum with a commercial starter feed (12.13 MJ/kg of ME, 22% CP) from hatch to 35 d of age. At d 35 of age (unpublished results), birds were transferred to a local private farm and reared straight-run until 180 d of age in outdoor pens at 8 m^2/bird density (Mosca et al., 2015). The pens were equipped with feeders, drinkers, and a suitable shelter to confine chickens at night or during bad weather. On transfer at 35 d of age, birds were randomly assigned to 2 pens (60 birds/pen, 31M:29F), corresponding to 2 replicates of the study, and fed ad libitum a crumbled vegetable diet that contained 16% crude protein, 4% lipids, 4% fiber, 6% ash, and 12.58 MJ/ME/kg until the age of slaughter (Mosca et al., 2016). The total amount of feed given to each group was recorded. Individual body weights were recorded weekly, as well as the cumulative feed intake of each group to estimate the overall mean feed consumption in the growing period. Bird mortality was recorded daily. Bird handling was in accordance with the principles presented in the Guidelines for the Care and Use of Agricultural Animals in Research and Teaching (FASS, 2010).

Slaughter and Carcass Weight

At 180 d of age, 10 birds per pen (5 males + 5 females) were randomly chosen and slaughtered after 8 h feed withdrawal. Chickens were stunned by electrocution (110 V; 350 Hz) before killing. After killing, carcasses were plucked and weighed. Then, non-edible viscera (intestines, proventriculus, gall bladder, spleen, esophagus, and full crop) were removed, and the weight of the partially eviscerated carcass (**PEC**) was recorded. Then the head, neck, legs, edible viscera (heart, liver, and gizzard) and fat (perivisceral, perineal, and abdominal) were removed in order to obtain the ready-to-cook carcass (**RCC**) (Romboli et al., 1996) and its weight. The proportion of the PEC and RCC of the live body weight was calculated. The weight of main viscera (intestines, spleen, heart, liver, and gizzard) was recorded. Fat weight was not recorded because a negligible amount of abdominal fat was present in all birds.

After processing, the RCC were cooled in a cold tunnel and refrigerated at 4°C for 24 hours. The right

breast and thigh with skin were subsequently removed and the following parameters recorded: color, pH, and water-holding capacity (**WHC**); chemical analysis also was performed in both meat cuts. The left breast and thigh without skin were immediately stored at −20°C for up to 20 d for cooking loss (**CL**) and tenderness evaluation.

Analytical Determinations

The right breast and thigh with skin were submitted to surface color determination using a Minolta CR-300 Chroma Meter (Minolta, Osaka, Japan) working as a CIELAB system (CIE, 1986). The brightness (L^*), red (a^*), and yellow (b^*) indices, which numerically describe the color parameters, were recorded at 6 locations on each sample. L^* is the amount of incident light that a surface reflects; $a^* < 0$ values represent green, and $a^* > 0$ values represent red color; $b^* < 0$ values represent blue, and $b^* > 0$ values represent yellow color. The skin was then removed from the muscles, and the underlying muscle was submitted to color parameters determination (as described above), pH measurement, WHC estimation, and chemical analysis.

Meat pH was measured using a pH meter HD 2105.2 (Delta Ohm, Caselle di Selvazzano, Italy) equipped with a probe that was inserted into the muscular tissue for approximately 6 mm. The WHC was determined using the method of Jauregui et al. (1981), with some modifications. Briefly, 1.5 ± 0.3 g of lean muscle were inserted into a pre-weighed (W1) funnel made of 4 layers of grade 1 filter paper (Whatman International, Maidstone, UK). The funnel with the sample was weighed (W2), put into a centrifuge tube, and centrifugated at 15,000 rpm for 15 min at 4°C. Then, the muscle sample was removed from the funnel and weighed again (W3). The WHC was calculated as percentage of water weight lost from the sample, with the formula (P3-P1)/(P2-P1)*100, where: (P3-P1) = water weight (absorbed by the paper), and (P2-P1) = initial meat weight.

Chemical analyses were performed both on breast and thigh muscles without skin. Breast and thigh meat samples were homogenized (Ultra Turrax T25, IKA) for 2 minutes. Moisture (950.46), total protein (981.10), ether extract (991.36), and ash (920.153) contents of the meat homogenates were analyzed in duplicate according to the AOAC (2000).

The frozen left breast and thigh samples were thawed at 4°C until thermal equilibration and submitted to CL determination; the samples were weighed and cooked following the method by Honikel (1998) with minor modifications. In brief, the samples were put into 190 × 300 mm, 65 μm thick Polysilk bags (Baglight®, Interscience, Saint Nom, France) and placed in a thermostatic water bath until they reached a targeted peak internal temperature of 80°C. Temperature measurements were obtained by a thermometer (735–2, Testo, Settimo Milanese, Italy) equipped with a probe (PT-100, Testo) inserted into the core of each sample. When the end-point temperature was reached, the bags were removed from the water bath and rapidly cooled under tap water and then chilled in a refrigerator until equilibrated (+4C); finally, the samples were weighed again, calculating the percentage of CL.

Finally, the tenderness of the cooked breast samples was determined as Warner–Bratzler shear force (**WBSF**) by an Instron universal testing machine (Model 5542, Instron Engineering Corp., Canton, MA). The analysis was performed on 6 subsamples (1.27 cm in diameter) from each sample. The shares were cut parallel to the longitudinal orientation of muscle fibers; the peak shear force was measured (Warner–Bratzler blade speed 200 mm/min), and mean values were recorded.

Table 1. Least square means of carcass weight data recorded in male and female Milanino chickens slaughtered at 180 d of age.

Carcass weight data[1]	Females	Males	s.e.
BW (g)	2318.40^{A}	2843.40^{B}	78.46
PEC (g)	1925.00^{A}	2301.00^{B}	68.56
RCC (g)	1471.50^{A}	1838.00^{B}	49.09
PEC (% BW)	87.49	85.67	0.67
RCC (% BW)	66.95	68.47	0.67
Intestines (g)	102.00	88.60	4.68
Cecum (g)	17.17^{A}	21.23^{B}	0.72
Gizzard (g)	54.33^{a}	68.33^{b}	3.79
Spleen (g)	2.43^{a}	3.36^{b}	0.23
Heart (g)	10.21^{A}	15.70^{B}	0.81
Liver (g)	36.04^{a}	41.11^{b}	1.11

[1]BW = live body weight; PEC = partially eviscerated carcass; RCC = ready-to-cook carcass.

^{A,B}Values within a row with different superscripts differ significantly at $P < 0.001$ between the sexes.

^{a,b}Values within a row with different superscripts differ significantly at $P < 0.05$ between the sexes.

Statistical Analysis

Analysis of variance was performed on carcass weight and meat quality data using the GLM procedure of SAS (SAS, 1999). The statistical model included pen and sex as sources of variation. The source of variation "pen" was not significant in all traits; therefore, it was discarded from the model. A t test was used to compare LSMeans.

RESULTS

Slaughter Performance

According to the results of the analysis of variance, the sex significantly affected the carcass weight data. All significant results related to the slaughter performance are reported in Table 1.

As expected, the live body weight (BW) measured before slaughter was higher in males compared to females ($P < 0.001$). The weight of the PEC and RCC showed the same differences between sexes ($P < 0.001$); in contrast, the proportion of PEC and RCC was very

Table 2. Least square means of chemical meat composition recorded in male and female Milanino chickens slaughtered at 180 d of age.

	Females	Males	s.e.
Breast muscle			
Dry matter (%)	28.78^{A}	27.64^{B}	0.22
Total proteins (%)	26.37^{a}	25.62^{b}	0.18
Total lipids (%)	0.23^{A}	0.10^{B}	0.02
Ash (%)	1.18	1.16	0.02
Thigh muscle			
Dry matter (%)	27.40^{A}	25.19^{B}	0.23
Total proteins (%)	21.25	21.27	0.21
Total lipids (%)	2.67^{A}	0.74^{B}	0.31
Ash (%)	1.08	1.09	0.01

^{A,B}Values within a row with different superscripts differ significantly at $P < 0.001$ between the sexes.
^{a,b}Values within a row with different superscripts differ significantly at $P < 0.05$ between the sexes.

similar in males and females ($P > 0.05$). The weight of all viscera, except the intestines, was higher in males compared to females ($P < 0.05$).

The overall mean feed consumption measured in the growing period, from 35 to 180 d of age, was very similar in both pens and corresponded to 92 g/bird/day. The cumulative feed consumption recorded was 13.3 kg/bird/145 d rearing period. Mortality recorded during the brooding period (1 to 35 d of age) was 0%. Mortality recorded during the growing period (36 to 180 d of age) was 1.8 and 3% in the first and second groups, respectively.

Meat Composition

According to the results of the analysis of variance, the sex affected the meat composition characteristics. All significant results related to the chemical composition of meat are reported in Table 2.

Dry matter ($P < 0.001$), protein ($P < 0.05$), and fat contents (%) ($P < 0.001$) of the breast meat were higher in females compared to males. In contrast, ash content (%) was very similar in the breast meat of both sexes ($P > 0.05$).

In the thigh meat, dry matter and fat contents (%) were higher in females compared to males ($P < 0.001$), while protein and ash contents (%) were very similar in thigh muscles ($P > 0.05$) of both sexes.

Physical-chemical Characteristics of the Meat

According to the results of the analysis of variance, the sex affected several physical-chemical parameters related to the meat quality. All significant results related to the meat color parameters recorded on both skin and muscles are reported in Table 3, while the results related to pH, WHC, CL, and tenderness (WBSF) of meat are reported in Table 4.

Significantly higher luminosity (L*) was observed on the skin of female carcasses, in both breast ($P < 0.05$) and thigh ($P < 0.001$) samples. The red (a*) index was higher ($P < 0.05$) on the skin of male breast samples, while the yellow (b*) index was higher ($P < 0.001$) on the skin of female breast samples.

Considering muscle color, higher ($P < 0.001$) values of the b* index were observed in female carcasses, in both breast and thigh, while a higher ($P < 0.001$) a* index was detected in male breast samples (Table 3).

No significant differences between pH values recorded in males and females were found in either breast (5.69 to 5.72) or thigh (6.03 to 6.10) meat (Table 4). WHC values ranged from 23 to 26% without variation between sexes. In contrast, CL values recorded in thigh samples were significantly lower in males compared to females ($P < 0.05$). The WBSF ranged from 12.2 to 13.6 Ncm^{-2} with no differences between males and females (Table 4).

Table 3. Least square means of breast and thigh muscular tissue (raw) coloration in male and female Milanino chickens slaughtered at 180 d of age.

	Index[1]	Females	Males	s.e.
Breast with skin	L*	64.78^{a}	61.26^{b}	0.88
	a*	− 1.96^{a}	3.40^{b}	0.28
	b*	9.19	6.91	1.01
Breast without skin	L*	50.79	50.68	0.86
	a*	1.22^{A}	3.95^{B}	0.43
	b*	4.65^{A}	2.95^{B}	0.30
Thigh with skin	L*	71.65^{A}	67.08^{B}	0.77
	a*	− 0.60	0.79	0.64
	b*	12.26^{A}	6.05^{B}	1.03
Thigh without skin	L*	42.16	42.13	0.75
	a*	13.98	12.96	0.97
	b*	7.37^{A}	5.51^{B}	0.45

[1]L* = lightness, a* = redness, b* = yellowness.
^{A,B}Values within a row with different superscripts differ significantly at $P < 0.001$ between the sexes.
^{a,b}Values within a row with different superscripts differ significantly at $P < 0.05$ between the sexes.

Table 4. Least square means of meat physiochemical characteristics recorded in male and female Milanino chickens slaughtered at 180 d of age.

Traits[1]	Females	Males	s.e.
Breast muscle			
pH	5.69	5.72	0.03
WHC (%)	24.07	26.05	0.20
CL (%)	12.12	10.18	0.74
WBSF (Ncm^{-2})	12.26	13.66	0.73
Thigh muscle			
pH	6.10	6.03	0.03
WHC (%)	26.03	23.08	0.01
CL (%)	15.64^{a}	12.99^{b}	0.52

[1]WHC = water-holding capacity, CL = cooking loss, WBSF = Warner–Bratzler shear force.
^{a,b}Values within a row with different superscripts differ significantly at $P < 0.05$ between the sexes.

DISCUSSION

The Milanino chicken, as observed in previous studies (Mosca et al., 2015; Mosca et al., 2016), is characterized by a typical sexual dimorphism in relation to adult

body weight, being on average 2,843 g in males and 2,318 g in females at 180 d of age. Similar body weights have been reported in other Italian (Ermellinata di Rovigo, Robusta Maculata), Spanish (Mòs, Menorca), and Portuguese (Amarela, Preta Lusitanica, Pedres Portuguesa) chicken breeds (Rizzi and Chiericato, 2010; Zanetti et al., 2010; Soares et al., 2015). Furthermore, in all these European breeds, sexual dimorphism on adult body weight was a very clear trait (Soares et al., 2015). In contrast, lighter body weights were reported in several Italian chicken breeds, such as the Padovana (De Marchi et al., 2005; Zanetti et al., 2010), the Modenese and Romagnola (Sabbioni et al., 2006), and the Bionda Piemontese and Bianca di Saluzzo (Schiavone et al., 2015). These data confirmed Milanino a heavy breed that, according to the meat products typical of the Italian poultry market (Cerolini, 2008), could be reared to produce PEC or meat cuts.

In agreement with the clear sexual dimorphism in live BW, the weight of the PEC, RCC, and almost all the viscera was higher in males than in females. The PEC represents the traditional product derived from local breeds, and its weight in the 180-day-old Milanino chickens ranged between 1,856 and 2,232 g. In the Bresse chickens, the minimum carcass weight is 1,200 and 1,800 g for females and males, respectively (Verrier et al., 2005). The weight of the RCC ranged between 1,422 and 1,887 g and would be too heavy for the Italian poultry market (Cerolini, 2008); therefore, a shorter rearing period would be required in order to meet the RCC standard.

A good slaughter performance was recorded in the Milanino breed, and no differences between males and females were found. The general proportion of PEC and RCC yield was, respectively, 86 and 67%. Similar results have been reported in Portuguese breeds, even if the birds were slaughtered at the older age of 240 d (Soares et al., 2015). In contrast, a lower proportion of RCC yield, ranging between 58 and 63%, was reported in many other Italian chicken breeds (Sabbioni et al., 2006; Zanetti et al., 2010; Schiavone et al., 2015). Therefore, the Milanino breed has better slaughter performance than many other Italian meat-type genotypes. However, the comparison of data from different reports is difficult due to different rearing systems, diets, and ages at slaughter.

Compared with the standard broiler, the local chicken breeds are characterized by lower carcass fat (Culioli et al., 1990). The chemical composition of Milanino meat confirms this result being characterized by high protein and low fat contents compared to the standard broiler meat (USDA, 2017).

The chemical composition of breast and thigh meat showed variations according to the sex. In females, meat contains higher proportions of dry matter (breast and thigh), protein (breast), and fat (breast and thigh). In the Padovana chicken breed, similar effects of the sex on the chemical composition of the breast meat were found (De Marchi et al., 2005). In general, the protein and fat content found in Milanino breast meat were, respectively, higher and lower than those measured in many other European breeds (Sabbioni et al., 2006; Miguel et al., 2008; Zanetti et al., 2010; Schiavone et al., 2015; Amorim et al., 2016).

The comparison between thigh meat compositions of different local breeds is difficult due to the few data available. The fat content of male thigh was lower in Milanino birds compared to Portuguese Castellana Negra birds (Miguel et al., 2008). In contrast, the fat content of Milanino meat was higher than the fat content of meat obtained from the Spanish Mòs (Franco et al., 2012) and the Thai indigenous breed, one of the native breeds commonly raised under family farming systems in Thailand (Wattanachant et al., 2004).

For consumers, color and overall look are the initial preference criteria when purchasing a raw chicken product (Castellini et al., 2008), and it has been reported that breed is a factor that affects poultry meat color (Fletcher, 2002). Milanino meat, with and without skin, had an intense luminosity, and this trait was higher in the females. In particular, the L^* index was higher in thigh than in breast skin; in contrast, the opposite result was reported in Castellana Negra meat cuts (Miguel et al., 2008). L^* values of meat with skin were higher in Milanino compared to Italian Padovana (De Marchi et al., 2005), Spanish Castellana Negra (Miguel et al., 2008), and Thai indigenous chickens (Wattanachant et al., 2004). The skin of Milanino did not present blue-green color, with the exception of the female breast skin having a negative value of a^* index. The Milanino meat muscles presented values of a^* and b^* indices > 0 in agreement with Wattanachant et al. (2004) who reported an increase in L^*, a^*, and b^* values in indigenous chickens as compared with broilers of similar weight. Similar results were found in many other European breeds (Miguel et al., 2008; Franco et al., 2012; Amorim et al., 2016), despite the differences in age at slaughter and the increase in pigments with aging (Touraille and Ricard, 1981). In contrast, De Marchi et al. (2005) reported a bluish meat color in the Padovana breed. The thigh meat of Milanino chickens represents a very peculiar condition: very bright skin color is associated with high a^* and b^* values, being intensely colored. This condition could be positive for consumers because the intensity of meat color appears as an important parameter to assess eating quality of poultry meat (Farmer et al., 1997). A similar condition was described in the Spanish Castellana Negra breed (Miguel et al., 2008).

The pH values in both breast and thigh muscle measured 24 h postmortem were similar to those reported in many autochthonous breeds (Wattanachant et al., 2004; De Marchi et al., 2005; Miguel et al., 2008). Wattanachant et al. (2004) found higher pH values in broilers compared to Thai indigenous chickens, and the pH differences between the genotypes were suggested to explain the differences in meat color, considering

that muscle pH and meat color are positively correlated (Fletcher, 1999).

The CL of Milanino meat ranged from a minimum of 10%, recorded in male breast, to a maximum of 16%, recorded in female thigh. The CL of Milanino meat was appreciably lower when compared with the 33% reported in organic chickens (Castellini et al., 2002), the 19% (breast) in broilers (Wattanachant et al., 2004), and the range 19 to 23% in other local breeds (Wattanachant et al., 2004; Miguel et al., 2008). The CL in thigh meat was higher in female than in male Milanino chickens, according to previous results reported in broilers (Dransfield and Sosnicki, 1999).

The degree of tenderness of Milanino meat was not influenced by the sex, in agreement with similar data reported in the Padovana breed (De Marchi et al., 2005). The WBSF value measured in Milanino breast was higher than the one reported in broilers (Wattanachant et al., 2004), but lower than the one measured in many other breeds (Wattanachant et al., 2004; De Marchi et al., 2005; Dìaz et al., 2010; Zanetti et al., 2010). Tenderness is one of the most important criteria shaping consumer preference toward chicken meat quality (Imran et al., 2014). The values of shear force increase with aging in different species due to an increase in the hardness of the connective tissue and in the collagen cross-linking (Fletcher, 2002). Despite the old slaughter age of Milanino birds, the shear force values were largely lower than 4 $kg^{*}cm^{-2}$, considered the upper limit to separate tender and tough beef steaks (Delgado et al., 2006).

In conclusion, Milanino is a heavy Italian chicken breed characterized by a high carcass yield. Moreover, Milanino meat had high protein and low fat contents compared to the standard broiler meat. The skin of breast and thigh had high brightness, and the meat appeared intensely colored. The meat's potential loss of water and toughness were low compared to other local breeds of chicken.

Further studies are required to deeply assess the nutritional profile and the sensory characteristics of Milanino meat, to support the rearing of the local breed for meat production.

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