Free-range rearing density for male and female Milanino chickens: carcass yield and qualitative meat traits

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Primary Audience: Live Production Personnel, Free-range and Organic Farmers, Nutritionists, Researchers

SUMMARY

The Milanino is a heavy Italian chicken breed and represents an important genetic resource for alternative production systems. In order to support its promotion in the market according to consumer expectations on healthy nutrition and animal welfare, this trial aims to study the slaughter performance and the meat quality in male and female Milanino chickens kept at different rearing density in a separate-sex free-range system. A total of 140 birds (70M:70F) were reared in outdoor pens from 75 to 235 d of life according to the following experimental groups (35 birds/group): M2) males in 2 m^2/bird; F2) females in 2 m^2/bird; M10) males in 10 m^2/bird; F10) females in 10 m^2/bird. At 235 d of age, 6 birds per group were slaughtered. Slaughter performance and meat quality were assessed. The Milanino chicken is characterized by high carcass weight and carcass yield among local chicken breeds, and a rearing density of 10 m^2/bird is recommended for male birds to obtain heavier carcasses. Milanino meat appears bright and intensely colored, and it is characterized by high protein and low fat contents compared with the standard broiler meat. Total lipids of Milanino meat are characterized by a healthy fatty acid composition, corresponding to a high PUFA/SFA ratio. Milanino breast meat is a good supply of nutraceutical PUFA with a positive low n-6/n-3 PUFA ratio. The ability of the Milanino breed either to synthesize or to transfer to tissue a high quantity of PUFA relevant for human health could be a key factor for its economic valorization.

Key words: autochthonous chicken breed, free-range, rearing density, meat composition, fatty acids

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DESCRIPTION OF THE PROBLEM

Over the last centuries, Western diets acquired a dramatic imbalance in the ratio of polyunsaturated fatty acids (**PUFA**) to saturated fatty acids (**SFA**). Low ratios of PUFA to SFA are strongly associated with coronary heart disease and arteriosclerosis, which are among the most important causes of human mortality in developed countries [1, 2]. In addition, PUFA contents of modern diets present a reduction in the proportion of n-3 fatty acids leading to high n-6/n-3 fatty acid ratio, which is responsible for the pathogenesis of many diseases, including cardiovascular disease, cancer, and inflammatory disease [2, 3]. On the contrary, dietary intake of PUFA has been shown to reduce the risk of cardiovascular disease: the recommended ratio of PUFA to SFA should be above 0.4, and the ratio of n-6/n-3 PUFA should be less than 4.0 [4, 5].

Among meat products, poultry meat has been considered one of the main sources of PUFA, in particular n-3 PUFA, for human diets [6, 7]. To date, the consumption of chicken meat is increasing according to the recommendations of healthy nutrition [8]. Furthermore, consumer interest in alternative poultry products, such as organic and free-range chickens, is expanding [9]. In particular, consumer concern on welfare is increasing, and free-range systems based on low bird density are perceived as a priority [10].

It is well known that fresh forage plants is a good source of PUFA and free-range chickens are expected to eat variable amounts of forages that could modify fatty acid profile in their meat, as largely assessed in ruminants [11]. In addition to diet, other factors such as genotype, sex, and rearing system can affect meat quality and, in particular, the fatty acid composition [9, 12, 13]. Many findings revealed that fast-growing genotypes are not adapted to extensive rearing conditions, as they exhibit muscular-skeletal problems and very low motor activity and foraging behavior [13, 14]. On the contrary, slow-growing genotypes, such as autochthonous breeds, have a true adaptability to different local conditions and a good pasture production [15, 16].

In Italy, over the past decade, the amplified demand for traditional local food products has opened new prospects concerning the poultry production system and rearing using local breeds has been increasing.

Milanino is a heavy Italian chicken breed traditionally reared for meat production at the beginning of the last century [17, 18], but quickly replaced by the fast-growing strain lines selected to develop the intensive poultry sector. The Milanino breed was recently included in a conservation program [19] and few trials have been carried out to build up knowledge on its morphological characteristics [20], and breeding [21], growing, and slaughter performance [22, 23] in order to assess the productive potential of the breed to develop niche local poultry products. Qualitative meat traits have been also studied [24]; however, new data are required to better characterize Milanino meat quality in order to support its promotion in the market according to consumer expectations.

The aim of this trial was to study the slaughter performance and the meat quality, including the fatty acid composition of total lipid, in male and female Milanino chickens kept at different rearing density in a separate-sex free-range system.

MATERIALS AND METHODS

Rearing System and Slaughter Performance

The study was carried out during the 2017 reproductive season, from March to November. The trial was approved by the Committee for Animal Welfare of the University of Milan (OPBA_24_2017) according to the EU Directive 2010/63/EU. Bird handling was in accordance with the principles presented in Guidelines for the Care and Use of Agricultural Animals in Research and Teaching [25].

A total of 160 Milanino chickens (82M:78F) were hatched at the Poultry Unit, Animal Production Centre, University of Milan (Lodi). Birds were reared from 1 to 75 d of age in indoor pens following standard management guidelines for chickens, and from 76 to 235 d of age in outdoor pens with natural vegetation. At the outdoor transfer, birds were sexed and randomly assigned to the following groups according to a sex*rearing density experimental factorial design: group M2) males in 2 m^2/bird; group F2) females in 2 m^2/bird; group M10) males in

10 m^2/bird; group F10) females in 10 m^2/bird. Birds were fed ad libitum with a commercial starter feed (12.13 MJ/ME/kg, 22% crude protein, 3% lipids, 3% fiber, 5% ash) from hatch to 35 d of age, and with a commercial grower feed (12.58 MJ/ME/Kg, 19% crude protein, 4% lipids, 3% fiber, 5% ash) from 35 to 235 d of age.

At 235 d of age, 6 birds per group were randomly chosen, weighted, and slaughtered after 8 h feed withdrawal. Chickens were killed by cervical dislocation, mechanically plucked, fully eviscerated and deprived of head, neck, and legs in order to obtain the ready-to-cook carcass (**RCC**) [26]. Carcasses were weighted soon after slaughter and after refrigeration at 4°C for 24 h. The proportion of the RCC on the live body weight was calculated.

The right breast and thigh without skin were removed and stored to –20°C until meat quality analyses. Color parameters, proximate composition, and fatty acid composition of total lipid (**FAC-TL**) were determined in both meat cuts.

Analytical Determination

Color Parameters. Meat color was assessed on the surface of breast and thigh meat without skin. Color was measured in triplicate at different locations with homogeneous surface in each sample using a chromometer [27]. The CIE-Lab system values of lightness (L^*), redness (a^*), and yellowness (b^*) were recorded [28].

Proximate Composition. Moisture, fat, protein, and ash were determined in breast and thigh meat following the AOAC methods [29]. Moisture content was determined by drying samples in an oven at 105°C for 16 to 18 h until a constant weight was reached. Total protein was determined by the Kjeldahl method [30]. Ash was determined by incineration of sample in a muffle furnace at 650°C for 18 h. Total lipids were extracted and quantified according to the Folch method [31].

Fatty Acid Composition. FAC-TL was determined by gas chromatography after conversion of the fats to fatty acid methyl esters (**FAMEs**) according to the procedure described by Christie [32]. Briefly, the lipid sample (20 mg) was dissolved in 10% methanolic hydrogen chloride (2 mL) and 1 mL toluene solution of tricosanoic acid (1 mg mL^{-1}) was added as internal standard. After overnight heating at 50°C, 2 mL 1 M potassium carbonate and 5 mL 5% NaCl were added and then FAMEs extracted with 2 × 2 mL hexane. FAME separation was performed using a gas chromatograph [33] equipped with a split-splitless injector (split ratio 1:100), a 60 m capillary column [34], and a flame ionization detector. The carrier gas was helium with a flow rate of 1.0 mL min^{-1} and an inlet pressure of 16.9 psi. The oven temperature program for separation was from 120 to 175°C at 10°C min^{-1}, held for 10 min, and then from 175 to 230°C at 5°C min^{-1} and held for 5 min. Fatty acids were identified by comparison of retention times with Supelco® 37 component FAME mix and standard Menhaden fish oil [35], and were expressed as percentage of total fatty acids.

Statistical Analysis

Analysis of variance was performed on slaughter and meat quality data using GLM procedure of SAS [36]. The statistical model included sex, bird density, and meat cut as sources of variation, and the relative interactions (sex*bird density, sex*meat cut, bird density*meat cut, sex*bird density*meat cut). *T* test was used to compare LSMeans.

RESULTS AND DISCUSSION

The results of the analysis of variance on body weight (**BW**), RCC weight (**RCCW**), and meat quality parameters are shown in Table 1. The different sources of variation and the interactions sex*density and sex*meat cut significantly affected BW, RCCW, and meat quality, whereas the interactions density*meat cut and sex*density*meat cut were not significant and are not reported in Table 1.

BW and RCCW

The BW measured at 235 d of age before slaughter was significantly higher in males compared to females (mean values: 3,078 g in males vs. 2,443 g in females; $P < 0.001$). The RCCW showed the same significant difference between the sexes (mean values: 1,996 g in males vs

Table 1. Results of Analysis of Variance: *P* Values of the Sources of Variations and Relative Interactions Affecting Carcass and Meat Quality Parameters.

Carcass and meat parameters[1]	S[2]	D[2]	MC[2]	S*D	S*MC
Carcass weight data					
BW (g)	<0.001	<0.05	–	<0.05	–
RCC (g)	<0.001	<0.05	–	<0.05	–
RCC (% BW)	ns	ns	–	ns	–
Color parameters					
L*	<0.05	ns	<0.001	ns	ns
a*	ns	ns	<0.001	ns	<0.05
b*	ns	ns	<0.001	ns	ns
Meat composition					
Dry matter (%)	<0.001	<0.001	<0.001	<0.05	<0.05
Total proteins (%)	<0.001	<0.001	<0.001	<0.05	<0.05
Total lipids (%)	<0.001	ns	<0.001	ns	ns
Ash (%)	ns	ns	ns	ns	ns
Fatty acid profile					
16:0	<0.001	<0.05	<0.001	<0.05	ns
16:1n-7	<0.001	ns	<0.001	ns	<0.05
18:0	<0.001	ns	ns	ns	<0.05
18:1n-9cis	<0.001	ns	<0.05	ns	ns
18:1n-7cis	ns	ns	ns	<0.05	ns
18:2n-6	<0.001	<0.001	<0.001	ns	ns
20:4n-6	<0.05	ns	<0.001	ns	ns
24:0	<0.001	ns	<0.001	ns	ns
22:5n-3	<0.001	ns	<0.001	ns	ns
22:6n-3	<0.001	ns	<0.001	ns	ns
Partial sums					
SFA	<0.05	<0.05	<0.05	ns	ns
MUFA	<0.001	ns	<0.001	ns	ns
PUFA	<0.001	ns	ns	ns	ns
n-3	ns	ns	<0.001	ns	ns
n-6	<0.001	ns	ns	ns	ns
Ratios					
PUFA/SFA	<0.001	<0.05	ns	ns	ns
n-6/n-3	ns	ns	<0.001	<0.05	ns

[1]BW = live body weight; PEC = partial eviscerated carcass; RCC = ready-to-cook carcass; L* = lightness, a* = redness, b* = yellowness; SFA = saturated fatty acids; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids.
[2]S = sex; D = bird density; MC = meat cut.

Table 2. Carcass Weight Data in Male and Female Milanino Chickens Reared According to Different Bird Density and Slaughtered on 235 d of Age.

	Females		Males		
Carcass weight data[1]	2 m^2/bird	10 m^2/bird	2 m^2/bird	10 m^2/bird	SE
BW (g)	2433.40[a]	2453.10[a]	2866.50[b]	3290.00[c]	83.93
RCC (g)	1541.50[a]	1584.12[a]	1849.87[b]	2144.75[c]	63.95
RCC (% BW)	63.32	64.51	64.54	65.20	0.93

[1]LSMeans of carcass weight data are shown. BW = live body weight; RCC = ready-to-cook carcass.
[a–c]Values within a row with different superscripts differ significantly at $P < 0.05$.

1,562 g in females; $P < 0.001$). Bird density significantly affected both BW and RCCW; however, the effect was sex dependent and present only in males who showed the highest weights at the lower density of 10 m^2/bird (Table 2). On the contrary, female chickens showed very similar BW and RCCW, irrespective of rearing density (Table 2). Despite the significant difference in BW and RCCW found between sexes and between densities within males, no

differences in carcass yield were found among groups (Table 2). In males, the effect of rearing density on BW, and then also on RCCW, could be related to the sexual behavior that includes fights among birds at the onset of sexual maturity and the frequency of fights has been positively related to bird densities [37–39].

The present results confirm the characteristic sexual dimorphism related to adult body weight already shown in Milanino chickens in previous reports [22–24]. A similar sexual dimorphic trait was typically described in many other autochthonous chicken breeds [40–42]. Milanino is also confirmed to be a heavy Italian chicken breed compared to other Italian breeds [43–46].

The overall mean carcass yield recorded in male and female Milanino chickens at 235 d of age was 64%. In the same breed, similar results were previously found in birds slaughtered at the earlier age of 150 d [23], whereas higher values (66–68%) were reported in birds slaughtered at 180 [24] and 185 d of age [22]. These results suggest the need to better characterize body development during the growing period in order to optimize the slaughter age and performance in the slow-growing Milanino birds.

Similar carcass yield data have been also reported in Portuguese breeds [41]. In contrast, a lower proportion of RCCW was reported in other Italian chicken breeds slaughtered at similar ages, being 58% in the Bionda Piemontese e Bianca di Saluzzo [46] and 62% in the Romagnola and Modenese breeds [44].

Meat Quality Parameters

Color parameters were significantly affected by sex and meat cuts (Table 1), and the mean values are reported in Table 3. Significantly higher lightness (L^*) was observed on the meat of female birds ($P < 0.05$) and on the breast samples ($P < 0.001$). Higher ($P < 0.001$) values of red (a^*) and yellow (b^*) index were observed in thigh samples (Table 3). In addition, the interaction sex*meat cut significantly affected the a^* index that presented higher values in male compared to female breast samples (3.51 vs. 1.43, $P < 0.05$).

It is recognized that genotype is a factor affecting poultry meat color [47], and the meat of Milanino chickens showed specific muscle color characteristics. The Milanino meat muscles presented an overall intense lightness and values of a^* and b^* index > 0, in agreement with Wattanachant et al. [48] who reported an increase in L^*, a^*, and b^* values in indigenous chickens as compared with broilers of similar weight. Consistent results were found in many other European breeds [49–51] slaughtered on similar age, whereas a bluish meat color ($a^* < 0$) was observed in the meat of the Italian Padovana breed [43]. For consumers, color and overall look are the initial preference criteria when purchasing a raw chicken product [52], and the lightness and intensity of meat color represent important parameters to assess eating quality of poultry meat [53]. According to the present results, consumer preference could be focused on female meat, which presented overall higher lightness, and on thigh meat, being more intensely colored.

The proximate composition of meat, with the exception of ash, was significantly affected by sex and meat cut; dry matter and protein were also significantly affected by bird density (Table 1). The proximate composition of meat according to sex, bird density, and meat cut is shown in Table 4. Significant higher values in dry matter, protein, and fat content were found in female compared to male meat. A significant

Table 3. Muscular Tissue (Raw) Coloration Recorded by Sex and Meat Cut in Milanino Chickens Slaughtered on 235 d of Age.

	Sex		Meat cut		
Index[1]	Females	Males	Thigh	Breast	SE
L^*	49.02[a]	46.70[b]	43.30[C]	52.30[D]	0.51
a^*	8.13	8.88	14.50[C]	2.47[D]	0.36
b^*	6.33	5.50	7.26[C]	4.57[D]	0.38

[1]L^* = lightness, a^* = redness, b^* = yellowness. Values are shown as LSMeans.

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

[C,D]Values within a row with different superscripts differ significantly at $P < 0.001$ between the meat cuts.

Table 4. Chemical Meat Composition Recorded by Sex, Bird Density, and Meat Cut in Milanino Chickens Slaughtered on 235 d of Age.

	Sex		Bird density		Meat cut		
Meat composition[1]	Females	Males	2 m^2/bird	10 m^2/bird	Thigh	Breast	SE
Dry matter (%)	27.20^A	26.00^B	27.20^C	26.00^D	25.40^E	27.80^F	0.19
Total proteins (%)	23.80^A	23.12^B	24.01^C	22.91^D	21.71^E	25.20^F	0.19
Total lipids (%)	2.04^A	1.65^B	1.86	1.82	2.42^E	1.26^F	0.10
Ash (%)	1.32	1.21	1.32	1.21	1.19	1.34	0.05

[1]LSMeans of chemical meat composition are shown.

[A,B]Values within a row with different superscripts differ significantly at $P < 0.001$ between sexes.

[C,D]Values within a row with different superscripts differ significantly at $P < 0.001$ between bird density.

[E,F]Values within a row with different superscripts differ significantly at $P < 0.001$ between meat cuts.

higher content in dry matter and protein was also found in birds kept at the higher rearing density (Table 4); however, according to the significant interaction sex*density (Table 1), this effect was sex dependent and present only in male birds (2 m^2 vs. 10 m^2/male: dry matter = 27.00 vs. 25.01% ± 0.27; total proteins = 24.10 vs. 22.21% ± 0.27; $P < 0.05$). The effect of bird density on the proximate meat composition of male birds is probably associated to the same effect observed on BW. Males kept at the high rearing density may spend more time fighting than feeding and, consequently, their feed and water intake will decrease. Therefore, the male meat could present a lower moisture and, consequently, a higher dry matter content. The protein content, being the most proportion of dry matter, would reflect this condition.

Breast meat was characterized by a significant higher content in dry matter and protein and lower content in fat compared to thigh meat (Table 4). Furthermore in breast samples, the protein content was significantly higher in females compared to males, being 25.90% vs. 24.60% ± 0.27 ($P < 0.05$).

The different meat composition found between sexes and meat cuts in this study is consistent to that reported in previous studies [23, 24]. The very high protein content in female breast meat also confirms previous results reported in the same breed [24] and in the Padovana [43]. In addition, Milanino breast meat showed a low fat content if compared to many other European breeds [44–46, 49, 51], encouraging the marketing of the Milanino breast meat, according to the modern consumer expectations [54].

Fatty Acid Composition

The major fatty acids identified in total lipids of Milanino chicken meat were the saturate C16:0 (24.66%), the monounsaturated C18:1n-9 (26.63%), and the polyunsaturated C18:2n-6 (17.84%); consistent proportions of C18:0 (12.02%) and C20:4n-6 (7.73%) were also found. The proportion of the majority of fatty acids showed significant changes according to the sex and the meat cut, whereas only few fatty acids were significantly affected by bird density and the interactions sex*density and sex*meat cut (Table 1).

The fatty acid composition and several related values observed in male and female meat and in breast and thigh meat are reported in Table 5. The mean proportion of all fatty acids, except C18:1n-7, was significantly different between sexes and, as a consequence, the content of total saturated (SFA) ($P < 0.05$) and polyunsaturated (PUFA) ($P < 0.001$) fatty acids was significantly increased, with a concomitant significant decrease in monounsaturated fatty acids ($P < 0.001$), in male compared to female meat. The increased proportion of PUFA in male meat was also associated with a significant increase in the n-6 proportion ($P < 0.001$) and the PUFA/SFA ratio ($P < 0.001$) (Table 5).

The content of the major fatty acids C16:0, C18:1n-9, C18:2n-6, and C20:4n-6 was significantly different between breast and thigh cuts (Table 5). The proportion of SFA ($P < 0.05$) and n-3 PUFA ($P < 0.001$) was significantly higher in breast compared to thigh meat; as a consequence, the n-6/n-3 ratio ($P < 0.001$) significantly decreased in the same cut (Table 5).

Table 5. Fatty Acid Profile Recorded by Sex, Bird Density, and Meat Cut in Milanino Chickens Slaughtered on 235 d of Age.

	Sex[2]		Meat cut[3]		
Fatty acid profile[1]	F	M	T	B	SE
Fatty acids					
16:0	25.73^{A}	23.52^{B}	23.00^{C}	26.21^{D}	0.28
16:1n-7	3.39^{A}	1.77^{B}	3.28^{C}	1.89^{D}	0.18
18:0	10.12^{A}	13.84^{B}	12.41	11.62	0.44
18:1n-9cis	28.71^{A}	24.50^{B}	28.01^{c}	25.21^{d}	0.70
18:1n-7cis	2.00	2.01	1.98	2.03	0.05
18:2n-6	16.71^{A}	18.90^{B}	20.32^{C}	15.31^{D}	0.30
20:4n-6	6.94^{A}	8.52^{B}	5.37^{C}	10.00^{D}	0.50
22:5n-3	0.53^{A}	0.03^{B}	0.51^{C}	1.05^{D}	0.05
22:6n-3	1.42^{A}	1.02^{B}	0.72^{C}	1.73^{D}	0.08
24:0	0.91^{A}	1.21^{B}	0.92^{C}	1.21^{D}	0.05
Partial sums					
SFA	38.33^{a}	40.14^{b}	37.92^{C}	40.42^{D}	0.55
MUFA	34.84^{A}	29.13^{B}	33.84^{C}	30.04^{D}	0.84
PUFA	26.83^{A}	30.73^{B}	28.24	29.54	0.48
n-3	2.51	2.62	1.82^{C}	3.31^{D}	0.11
n-6	24.32^{A}	28.11^{B}	26.22	26.11	0.40
Ratios					
PUFA/SFA	0.70^{A}	0.77^{B}	0.74	0.72	0.01
n-6/n-3	10.94	12.11	14.81^{C}	8.21^{D}	0.42

[1]LSMeans of fatty acid profile are shown. SFA = saturated fatty acids; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids.

[2]F = females; M = males.

[3]T = thigh; B = breast.

[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.

[C,D]Values within a row with different superscripts differ significantly at $P < 0.001$ between the bird density.

[c,d]Values within a row with different superscripts differ significantly at $P < 0.05$ between the bird density.

The C18:0 content was significantly increased in thigh compared to breast meat (15.72% vs. 12.43%, $P < 0.05$) in the male samples, whereas no significant difference was found in the C18:0 content between the 2 meat cuts (thigh = 9.56%, breast = 10.82%, $P > 0.05$) in female samples.

Meat obtained from birds reared to the higher density, corresponding to 2 m^2/bird, was characterized by a proportion significantly lower in C16:0 (23.98% vs. 25.33%, $P < 0.05$) and higher in C18:2n-6 (18.82% vs. 16.84%, $P < 0.001$). As a consequence, the SFA were significantly lower (38.32% vs. 40.15%, $P < 0.05$) and the PUFA/SFA ratio significantly higher (0.76 vs. 0.70, $P < 0.05$) in the meat of high density compared to low density birds. However, the effect of bird density on the content of C16:0 was sex dependent (interaction sex*density with $P < 0.05$) and present only in males (2 m^2/bird = 22.46% vs 10 m^2/bird = 24.74%, $P < 0.05$), not in females (2 m^2/bird = 25.52% vs 10 m^2/bird = 25.93%, $P > 0.05$). The n-6/n-3 ratio was also significantly affected by the interaction sex*density ($P < 0.05$) (Table 1). In male birds, similar n-6/n-3 ratio values were found in the meat, irrespective of the rearing density (11.64 at 2 m^2/bird vs. 10.24 at 10 m^2/bird, $P > 0.05$); in female birds, the n-6/n-3 ratio in the meat was significantly increased in the low density group compared to the high density group (13.07 vs. 11.16, $P < 0.05$).

At our knowledge, the fatty acid composition of the Milanino meat is reported for the first time. The fatty acid profile of muscles obtained from different anatomical region of Milanino birds is in agreement with the general different fat composition previously found in the breast and thigh meat of the dual-purpose Italian chicken breed Robusta Maculata and Ermellinata di Rovigo [55]. Breast meat is richer of long-chain PUFA as C20:4n-6, C22:5n-3, and C22:6

n-3 than thigh meat. These differences indicate a different lipid metabolism in the 2 different anatomical regions according to the recent study of Cui et al. [56], who found that some genes involved in fat metabolism were downregulated in the breast compared with the thigh. The proportion of PUFA with nutraceutical effect (C20:4n-3, C22:5n-3, and C22:6n-3) found in Milanino meat is higher than the proportion reported in commercial broilers [57] and similar to the one found in other Italian chicken breeds [45] and in slow-growing poultry genotypes farmed in organic and similar systems [58,59]. The ability of local breeds either to synthesize or to transfer to tissue a high quantity of PUFA relevant for human health could be a key factor for their economic valorization.

The different fatty acid composition found between chicken groups farmed at different densities might be related to a different feeding behavior related to the stress rearing condition experienced by the 2 sexes. In male birds, not in females, the high rearing density is supposed to increase fighting behavior and a competitive feeding behavior affecting quality and quantity of the diet consumption can be also supposed. Further studies are required to improve the knowledge on feeding behavior and consumption in local breeds and its relation with sex, age, rearing condition, and feed preference.

CONCLUSIONS AND APPLICATIONS

1. The Milanino chicken is confirmed to be a heavy breed suitable for meat production providing a carcass weight of 1,780 g and a carcass yield of 64% at 235 d of age.
2. The lower rearing density of 10 m^2/bird is recommended for male, not female, birds to obtain heavier carcasses.
3. Milanino meat appears bright and intensely colored, and it represents an alternative chicken meat product according to the current market demand.
4. Milanino meat is characterized by high protein and low fat contents compared with the standard broiler meat. In particular, the composition of the female breast provides the best nutritive values and meets the modern consumer expectations.
5. Total lipids of Milanino chicken meat are characterized by a positive fatty acid composition, corresponding to a high PUFA/SFA ratio, as recommended in a healthy diet.
6. Milanino breast meat is a good supply of nutraceutical PUFA, from both n-6 and n-3 families, with a positive low n-6/n-3 PUFA ratio.

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