Comparison of two chicken oxidative stability and other qualitative traits of the meat

Cesare Castellini, Alessandro Dal Bosco, Cecilia Mugnai, Martina Pedrazzoli

Dipartimento di Biologia Vegetale e Biotecnologie Agro-ambientali e Zootecniche.
Università di Perugia, Italy

Corresponding author: Dr. Alessandro Dal Bosco. Dipartimento di Biologia Vegetale e Biotecnologie Agro-ambientali e Zootecniche. Università di Perugia. Via Borgo XX Giugno 74, 06100 Perugia, Italy – Tel. +39 075 5857110 – Fax: +39 075 5857122 – Email: dalbosco@unipg.it

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ABSTRACT

The effect of genotype on the oxidative stability and other qualitative traits of chicken meat was studied. Two groups of 200 chicks (Ross 205 and Kabir) were reared according to the organic farming system. At 81 d of age 20 birds per group were slaughtered and after refrigeration (24 h at 4°C) of the carcasses, *Pectoralis major* muscles were excised for analyses. Samples were analysed after 0, 24, 48, 72 and 96 hours of storage at 4°C under continuous fluorescent illumination (2300 lux). The analyses concerned the chemical composition and the shear force (only at time 0) and the progress of several traits as pH, CIELAB values, Thiobarbituric Acid Reactive Substances (TBARS), panel test and fatty acid composition (at 0 and after 96 h). Genotype greatly affected the physico-chemical characteristics and the sensory evaluation. The meat from Ross chickens showed high TBARS values, perhaps due to selection for growth rate that reduced their adaptability to greater space allowance and to poorer environmental conditions; these higher TBARS values were also negatively correlated to lightness and yellowness. The initial level of TBARS affected the oxidative stability of breast meat during storage. The amount of TBARS showed significantly negative relationship with the sensory evaluation; breast meat of Kabir had higher scores for liking when the level of malondialdehyde was less than 2.5 mg kg^{-1}.

Key Words: Poultry organic system, Oxidative stability, Meat quality.

RIASSUNTO

CONFRONTO FRA DUE TIPI GENETICI DI POLLO ALLEVATI CON IL METODO BIOLOGICO: STABILITÀ OSSIDATIVA ED ALTRE CARATTERISTICHE DELLA CARNE

E' stato studiato l'effetto del genotipo di polli allevati con il metodo biologico sulla stabilità ossidativa e altre caratteristiche della carne ad essa correlate.A tale scopo sono stati utilizzati 2 gruppi di 200 pulcini (Ross 205 e Kabir) allevati secondo il sistema biologico. A 81 giorni di età 20 polli per gruppo sono stati macellati e dopo refrigerazione delle carcasse (24 h a 4°C), il muscolo Pectoralis major è stato separato e utilizzato per le analisi. I campioni sono stati analizzati dopo 0, 24, 48, 72 e 96 ore di conservazione a 4°C sotto illuminazione fluorescente continua (2300 lux). Le analisi hanno interessato la composizione chimica e la tenerezza (tempo 0) e l'evoluzione di alcune caratteristiche: pH, colore, sostanze reattive dell'acido tiobarbiturico (TBARS), analisi sensoriali e composizione acidica (0 e 96 ore). Il genotipo ha notevolmente influenzato le caratteristiche fisico-chimiche e la valutazione sensoriale. La carne dei polli Ross ha mostrato elevati valori di TBARS, probabilmente in relazione alla selezione per il tasso di accrescimento che ha ridotto la loro adattabilità ad ampi spazi ed alle più severe condizioni ambientali; inoltre tali valori erano correlati negativamente alla luminosità ed alla gradazione del giallo della carne. Il livello iniziale di TBARS ha influenzato la stabilità ossidativa della carne durante tutto il periodo di conservazione. I livelli di TBARS hanno mostrato una correlazione significativamente negativa con la valutazione sensoriale; la carne di Kabir ha fatto rilevare i più alti score di gradimento quando il livello della malondialdeide era inferiore a 2,5 mg kg^{-1}.

Parole chiave: *Allevamento biologico del pollo, Stabilità ossidativa, Qualità della carne.*

Introduction

Autocatalytic oxidation of lipids is the main factor responsible for altering the sensory and the nutritional characteristics of meat. The process starts immediately after slaughtering with a magnitude which greatly depends on the amount of free radicals present in the muscle and on its total antioxidant capacity.

The *post-mortem* response of meat is affected by the balance between pro- (eg. polyunsaturated fatty acids, metal ions) and anti-oxidant factors (α-tocopherol, vitamin C, polyphenols, carotenoids, GPX, SOD, etc).

Thus, in this composite process various factors including animal species, genotype, slaughtering age and farming system are involved. As regards the farming system some investigations (Castellini *et al.*, 2002b) have shown that the organic system, favouring the kinetic behaviour of animals, increases the muscle oxidative metabolism and consequently the amount of free radicals. Adaptation of the body to higher activity also seems depend on genetic strain. Modern meat-type birds, strongly selected for precocity and fast growing rates, do not benefit from large space; on the contrary, the high weight reached at the slaughter age required by EC Regulation 1809/99 (81 d) often results in lameness with negative repercussions on animal welfare.

However, due to economic reasons and to the difficulty of finding 'alternative' chick strains, the most common strains in the organic system frequently belong to these meat-type strains.

There have been few reports on the relationship between the meat oxidative stability of different poultry strains and the farming system (Farmer *et al.*, 1997; Lewis *et al.*, 1997).

The aim of this study was to assess the oxidative stability of meat from two different genotypes of chickens reared under the organic system and the relationships with some qualitative traits.

Material and methods

Animals, rearing system and sampling

Four-hundred female chicks of Ross 205 and Kabir strains were reared separately (2 groups of 200 birds each) under brooder lamps for three weeks at the experimental farm of the Department of Botany and Agri-environmental Biotechnology and Animal Science of the University of Perugia).

The trial was carried out from March to May 2005. The environmental temperature ranged from 15 to 25°C and the relative humidity from 65 to 75%. Incandescent lights (30 lux) placed at the bird level were used for illumination. Chicks were vaccinated against Marek and Newcastle diseases and coccidiosis (Paracox®).

At 21 days of age, chicks were moved to a littered house (0.10 m^2/bird) with access to a grassed paddock (4 m^2/bird); feeders were available both outdoors and indoors. Birds were fed *ad libitum* diets (1-13 d: starter; 14 d–slaughter: finisher) containing, as required by EC Regulation 1804/99, more than 80% organic ingredients.

At 81 days, as required by the EC regulation, after fasting for 12 hours, twenty chickens were randomly selected from each group. They were electrically stunned in a waterbath set to deliver a constant current of 50 Volt, 1.9A, 350 Hz for 7-10 sec., killed by manual exanguination, plucked and eviscerated. From the refrigerated carcasses (24 hours at + 4°C) *Pectoralis major* muscles were excised for analysis (0 hours).

Immediately before slaughter, blood samples were collected in heparinized vacutainers and centrifuged at 1,500 x g for 10 min at + 4°C, to measure the *in vivo* antioxidant capacity by the Oxyadsorbent test produced by Diacron® s.r.l. (Italy) (Cesarone *et al.*, 1999).

The content of the crop without the grit was weighed and analysed to compare the feeding behaviour of the strains.

Analytical determinations

Chemical analyses of crop contents and meat were performed according to AOAC methods (1995).

Alpha-tocopherol in the crop contents was extracted with diethylic-petrol ether (2:1) on 5 g of samples saponified with ethanol and KOH (50%). The homogenate was centrifuged (1,630 x g, 10 min) and the supernatant was transferred to a large test tube and dried to 0.5 ml under N_2 at 30-40°C. The pellet was re-extracted two more times with 20 vol of acetone and centrifuged. All supernatant fractions were combined and reduced to less than 1 ml

under N_2; 100 µl of the filtrate was then injected into the HPLC (Zaspel and Csallany, 1983).

Shear force was evaluated on cores (1.25 cm x 2 cm) obtained from the mid-portions of the cooked samples (roasted for 15 min.; core temperature 80°C) by cutting them perpendicularly to the fibre direction, using an Instron, model 1011, equipped with a Warner-Blatzler Meat Shear apparatus.

Meat pH, colour parameters, Thiobarbituric Acid Reactive Substances (TBARS), fatty acid composition and sensory characteristics were determined as described below.

The pH was measured with a Knick digital pHmeter (Broadly Corp., Santa Ana, CA, USA) after homogenization of 1 g of raw muscle for 30 sec in 10 ml of 5M iodoacetate (Korkeala *et al.*, 1986).

The colour was measured on the medial surface of each breast fillet using a tristimulus analyser (Minolta Chroma Meter CR-200), with the Cielab Colour System (1976) considering L* value for Lightness, a* value for redness and b* value for yellowness.

The extent of lipid oxidation was evaluated as TBARS by the modified method of Ke *et al.* (1977). Ten grams of minced muscles were homogenised for 2 min with 95.7 ml of distilled water and 2.5 ml of 4N HCl. The mixture was distilled until 50 ml was obtained. Then, 5 ml of the distillate and 5 ml of TBA reagent (15% trichloroacetic acid, 0.375% thiobarbituric acid) were heated in a boiling water bath for 35 min. After cooling under running tap water for 10 min, the absorbance was measured at 538 nm against a blank. TBARS values were obtained by multiplying optical density by 7.843. Oxidation products were quantified as malondialdehyde equivalents (mg MDA kg^{-1} muscle).

The fatty acid composition of breast meat was determined on lipids extracted from samples of about 5 g in a homogeniser with 20 ml of 2:1 chloroform/methanol (Folch *et al.*, 1957), followed by filtration through Whatman No. 1 filter paper. Fatty acids were determined as methyl esters with a Mega 2 Carlo Erba Gas Chromatograph, model HRGC (Milano, Italy), using a D-B wax capillary column (0.25 mm Ø 30 m long). The fatty acid percentages were calculated with the Chrom-Card software and the mean value of each fatty acid was used to calculate the following indexes:

- peroxidizability index (PI) = (% monoenoic x 0.025) + (% dienoic x 1) + (% trienoic x 2) + (% tetraenoic x 4) + (% pentaenoic x 6) + (% hexaenoic x 8) (Arakawa *and* Sagai, 1986);
- atherogenicity = (C12:0 +4xC14:0 + C16:0) / [(ΣMUFA + ΣSPUFA (n-6) and (n-3)] (Ulbricht and Southgate, 1991);
- thrombogenic = (C14:0 + C16:0 + C18:0) / [(0.5 x ΣMUFA + 0.5 x ΣSPUFA (n-6) + 3 x ΣSPUFA (n-3) + (n-3)/(n-6)] (Ulbricht and Southgate, 1991).

Sensory analyses

A 9-member experienced sensory panel performed the sensory evaluation of the meat. The samples were roasted (as above mentioned) without salt or spices and were immediately sliced into nine pieces that were randomly offered to panellists during four sessions. The traits assessed were: tenderness, juiciness (initial and final), fragmentation, residual and liking. A 5-point scale was used, 1 referring to very tough, very dry, very fibrous, with high amount of residual and disagreeable and 5 extremely tender, very juicy, without fibre and residual and very agreeable (Cross *et al.*, 1986).

Display conditions

Samples from the remaining portion, were placed on polystyrene packaging tray, overwrapped with PVC film (600 cm^2) and displayed at + 4°C under continuous cool white fluorescent illumination (2,300 lux).

The pH, colour, oxidation and sensory traits were determined again after 24, 48, 72 and 96 hours of storage, while the fatty acid profile was repeated only at the end of the storage period (96 h).

Statistical analyses

Data of antioxidant content of crop, *in vivo* antioxidant capacity and chemical composition tenderness and fatty acid profile of meat were analysed with a linear model (The R Foundation, Copyright 2002) including the fixed effect of genetic strain. Significance of differences was evaluated by t-test.

TBARS, pH colour and sensory attributes during display were analysed with a mixed model adapted to repeated measures (NLME package of the same software).

Results and discussion

The comparative analysis of the crop contents showed a different feeding behaviour among strains (Table 1). In particular the crop contents of Kabir chickens had higher amounts of α-tocopherol and carotenoids. Simultaneously these chickens showed an higher antioxidant capacity resulted from the antioxidant intake, the greater locomotory activity and the slower rate of maturing.

The chemical composition of the breast meat was affected by genotype (Table 2). Kabir had a significantly lower level of intramuscular fat ($P<0.05$) than Ross, while the other parameters were similar.

This trend could be partly explained considering the behaviour of these two strains. As observed in a previous experiment performed under organic conditions (Castellini *et al.*, 2002b), Ross chickens were less active, with less walking, more lying and less interest in the observer, and they spent more time indoors than outdoors with respect to the Kabir ones.

Meat-type chickens are genetically selected for attaining high body weight at an early age (40-50d) after which the high weight often determines lameness, negatively influencing animal welfare.

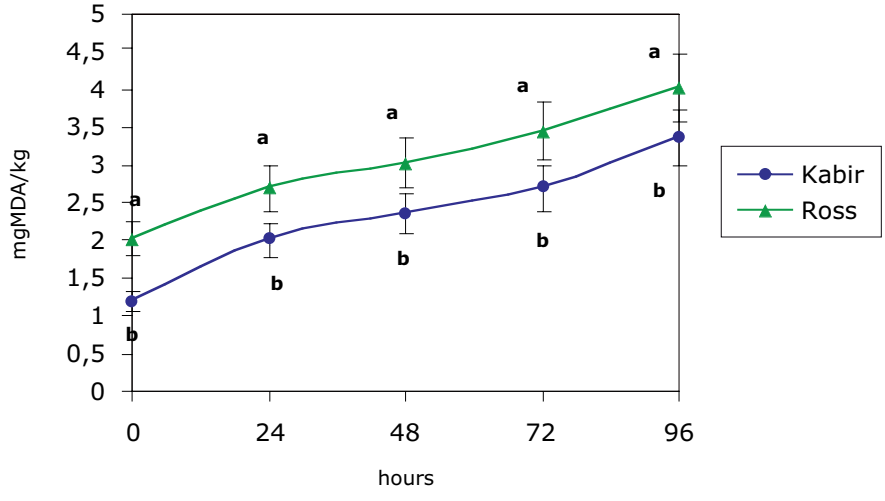
In the same time, the different selection towards precocity also explains the higher moisture and the lower protein content of Kabir chickens which are less mature at the same age. In fact at 81 days Ross birds weighed 2,942 g, which is about 70% of the degree of maturity, while at the same age Kabir chickens had a live weight of only 2,031 g (52% of the degree of maturity; Castellini *et al.*, 2002b; 2002c).

Shear force did not significantly differ between strains and both had very tender meat.

The oxidative status of the breast meat, evaluated as TBARS (Figure 1), was different in the genetic strains. In general, the meat of organic chickens has a considerable amount of malondialdehyde (Castellini *et al.*, 2002a) since the oxidative status of the organic animals is affected by the intense motor activity which in turn increases muscle oxidative metabolism and free radical production.

The lower TBARS level in the Kabir chickens was due, as already mentioned, to the higher antioxidant capacity, resulting from the higher antioxidant intake (α-tocopherol, carotenoids, etc.) and even to the leaner meat. Further, we have already shown that in medium or slow growing

Figure 1. Evolution of TBARS of chicken Pectoralis major muscle during display at 4°C under continuous fluorescent illumination.



For each group and time n=6. a,b = $P<0.05$.

Table 1. Antioxidant content of crop and in vivo antioxidant capacity in the different genotypes.

Genotype		Ross	Kabir	SEM
Carotenoids	mg kg^{-1}	17.0[b]	21.8[a]	1.8
α-tocopherol	"	34.1[b]	38.8[a]	3.2
Antioxidant capacity	μmol HClO ml^{-1}	541[b]	781[a]	67

For each group n=20; a,b = P<0.05.

Table 2. Chemical composition and tenderness of *Pectoralis major* in the different genotypes.

Genotype		Ross	Kabir	SEM
Moisture	%	75.36	76.03	0.39
Protein	"	22.77	22.32	0.87
Lipid	"	1.15[b]	0.85[a]	0.25
Ash	"	0.62	0.76	0.19
Shear value	Kg/cm^2	1.99	2.41	0.31

For each group n=20; a,b = P<0.05.

strains increase in locomotory activity and free-radical production is correlated with an adequate response of organism which develops a more efficient mechanism for controlling them (Alessio *et al.*, 2000).

It has been confirmed that exercise increases the number of mitochondria in αW fibres converting them into aR fibres (Ouhayoun, 1998) and that muscle oxidative capacity increases according to exercise (Petersen *et al.*, 1997). Furthermore, enhancement of the aerobic catabolism of pyruvate causes a sparing of glycogen, being the oxidative pathway more efficient to produce energy. According to previous findings (Castellini *et al.*, 2002c), the hypothetical greater availability of glycogen due to such mechanism could explain the lower value of the pH in Kabir birds.

Van der Wal *et al.* (1993) and Enfält *et al.* (1997) observed lower pH_u in *longissimus lumborum* and *biceps femoris* of outdoor reared pigs, and Maribo (1995) found the pH_u of *biceps femoris* to be lower in pigs reared in large pens when compared with rearing in conventional pens. Enfält *et al.* (1997) proposed that the lower pH_u in outdoor reared pigs could be due to a greater capacity to utilise substrates other than glycogen during transport to the slaughterhouse. In addition, Anderson *et al.* (1990) suggested that increased exercise and calmer behaviour make the animals less susceptible to stress in connection with transport and slaughter.

The evolution of pH during display was expected. During storage two opposite mechanisms occur (Hulot and Ouhayoun, 1999): rise in the level of NH_4 nitrogen (> pH) and the production of free fatty acids (< pH). These processes cause an initial increase in pH followed by levelling off. The same trend was observed in our trial with little difference according to genetic strain until 48 hours after which values became similar or equal as a consequence of the prevalent effect of storage.

Concerning the colour of breast meat, there was a negative correlation between lightness and pH as well as with yellowness. On the contrary lower values of redness did not correlate to lower pH_u values but this could be due to the above mentioned increase of αR fibres (richer in myoglobin) associated to the greater motor activity (Allen *et al.*, 1997; Fletcher, 1999).

In agreement with previous reports (Le Bihan-

Table 3. Major fatty acids (g/100g total fatty acids) and qualitative indexes of *Pectoralis major* at the beginning of display.

Genotype	Ross	Kabir	SEM
C14:0	0.57	0.85	0.44
C16:0	28.76^{a}	27.49^{b}	1.16
C18:0	9.06^{a}	8.19^{b}	0.70
Others	0.59	0.40	0.05
Σ SFA	38.98^{a}	36.93^{b}	2.40
C16:1n-7	1.88^{B}	2.70^{A}	0.37
C18:1n-9	25.58^{b}	27.02^{a}	2.50
C20:1n-9	0.17	0.14	0.09
Others	0.39	0.41	0.09
Σ MUFA	28.02^{b}	30.27^{a}	2.83
C18:2n-6	21.77^{a}	19.19^{b}	0.96
C20:4n-6	7.08	6.91	1.44
Others	1.33	1.11	0.21
LCP n-6	8.41	8.02	0.59
Σ n-6	30.18^{A}	27.21^{B}	1.49
C18:3n-3	0.55^{B}	1.52^{A}	1.13
C20:5n-3	0.19^{b}	0.49^{a}	0.02
C22:5n-3	0.17	0.17	0.10
C22:6n-3	0.99^{B}	1.65^{A}	0.20
Others	0.92	1.46	0.86
LCP n-3	2.27^{B}	4.07^{A}	1.02
Σ n-3	2.82^{B}	5.59^{A}	1.04
Σ PUFA	30.48	32.80	2.33
Atherogenicity index	0.49	0.48	0.01
Thrombogenicity index	0.88^{a}	0.74^{b}	0.04
Peroxidizability index	72.81^{B}	80.99^{A}	2.18

For each group n=20; a,b = P<0.05; A,B: P<0.01.

Duval *et al.*, 1999) the L* values increased in Ross birds during display. Conversely, the meat of Kabir birds showed little variation. The a* parameter showed a significant decrease in both groups mainly starting at 48 hours of storage. Yellowness decreased greatly until 48 hours successively levelled off. In Kabir birds the trend was irregular, having an erratic increase at 48 hours.

The fatty acid composition of the breast meat (Tables 3 and 4) showed significant variations due to genotype. The meat of Kabir chickens, compared with Ross, had a higher amount of n-3 PUFA (5.59 *vs* 2.82; P<0.01) at the beginning of storage, mainly LCP n-3 (4.07 *vs* 2.27; P<0.01), and a lower percentage of n-6 PUFA (27.21 *vs* 30.18; P<0.01). Thus, the potential stability of Kabir meat, quantified as PI, was lower (80.99 *vs* 72.81; P<0.01).

Moreover ,the nutritional quality, in spite of the high level of n-3 fatty acids, was better as demonstrated by the significantly lower Thrombogenicity index (0.74 *vs* 0.88; P<0.05).

Since the feed furnished was the same, this trend is presumably attributable to the greater ingestion of grass by Kabir chickens and to a presumable specific capacity to protect them. It is widely known that grass contains a considerable amount of linolenic acid (534 mg kg^{-1}) adequately protected with __tocopherol (162.3 mg kg^{-1}; Lopez Bote *et al.*, 1998). This fact is confirmed by the significant differences in the C18:3n-3 levels in kabir

Table 4. Major fatty acids (g/100g total fatty acids) and qualitative indexes of *Pectoralis major* at the end of display period.

Genotype	Ross	Kabir	SEM
C14:0	1.04	1.18	0.15
C16:0	31.11	29.81	1.01
C18:0	9.18	9.04	0.70
Others	0.72	0.27	0.05
Σ SFA	42.05[a]	40.33[b]	2.40
C16:1n-7	2.25[b]	2.38[a]	0.37
C18:1n-9	25.09	25.92	2.50
C20:1n-9	0.16	0.21	0.09
Others	0.63	0.25	0.09
Σ MUFA	28.07[b]	28.76a	2.83
C18:2n-6	19.05	18.64	0.96
C20:4n-6	7.34	7.35	1.44
Others	0.92	1.08	0.21
LCP n-6	8.26	8.84	0.59
Σ n-6	27.31	26.92	1.49
C18:3n-3	0.53	0.99	0.13
C20:5n-3	0.18	0.31	0.09
C22:5n-3	0.23	0.21	0.10
C22:6n-3	0.58[b]	0.92	0.20
Others	1.05[b]	1.36[a]	0.86
LCP n-3	2.71[a]	3.48[b]	1.02
Σ n-3	2.57[b]	3.99[a]	1.04
Σ PUFA	27.44[b]	30.91[a]	2.33
Atherogenicity index	0.61	0.58	0.08
Thrombogenicity index	1.10	1.00	0.14
Peroxidizability index	67.25	73.10	2.47

For each group n=20; a,b = P<0.05; A,B: P<0.01.

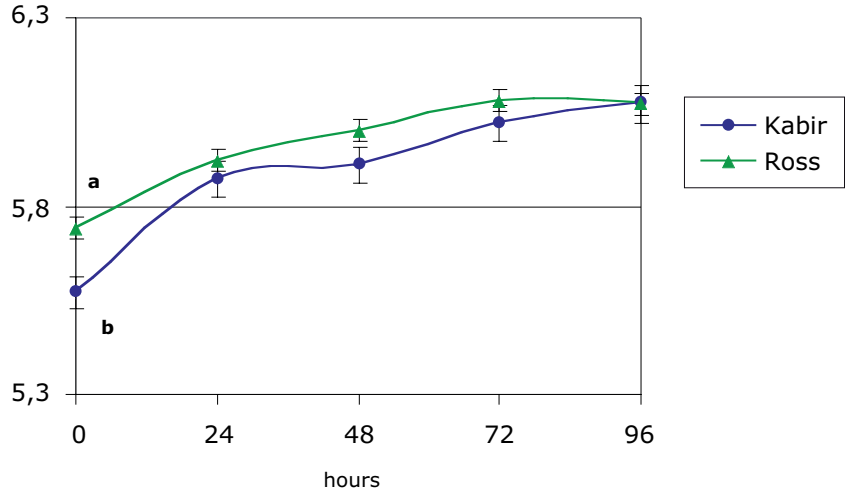
meat (0.55 *vs* 1.52%; P<0.01).

During storage, a reduction in unsaturation fatty acids and consequently of PI occurred in both groups but was more relevant in Kabir chickens; in particular this decrease concerned C18-3:n-3 rather than LCP n-3. However, in spite of the higher PI and of n-3 fatty acid degradation, Kabir chickens had a lower amount of malondialdehyde during all the storage period with respect to Ross ones.

The achievement in the meat of a large amount of PUFA, sufficiently stable, largely depends on in vivo conditions and follows a complex equilibrium in which numerous factors play a different role. For example the kinetic activity increases the antioxidant capacity, reduces fat and indirectly increases the grass intake; simultaneously ROMS (Reactive Oxygen Metabolites substances) and meat iron increases Castellini *et al.*, 2002c). Such balance is modulated by genotype, season and farming system. In fact, in this specific case it could be useful to consider the different levels of fat between genotypes as well as the different amounts of pro-oxidant factors; in our previous research, comparing the breast meat of Kabir and Ross chickens we found a significantly higher level of muscular iron in Kabir meat (total: 6.45 *vs* 4.15 mg kg^{-1}; haeme 2.94 *vs* 1.89 mg kg^{-1}; Castellini *et al.*, 2002c).

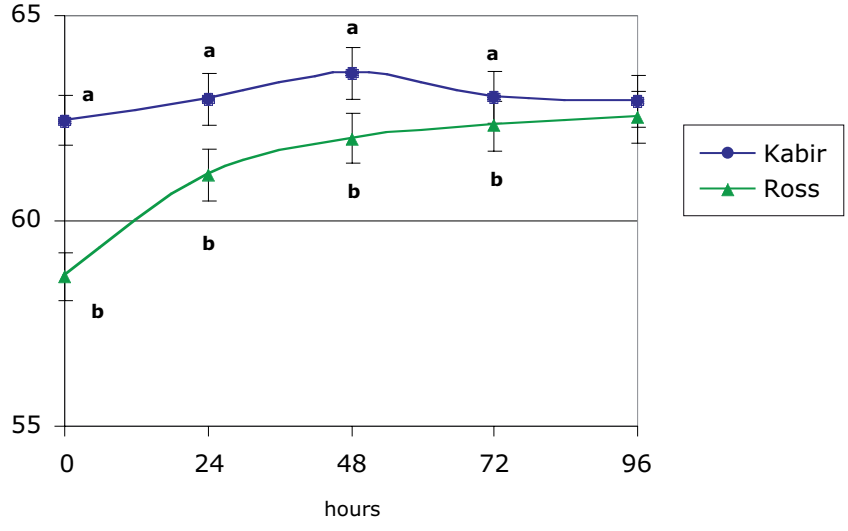
The results of the panel test (Figures 8 – 11)

Figure 2. Evolution of pH *pectoralis major* of chicken *Pectoralis major* muscle during display at 4°C under continuous fluorescent illumination.



For each group and time n=20. a,b = P<0.05.

Figure 3. Evolution of L value of chicken *Pectoralis major* muscle during display at 4°C under continuous fluorescent illumination.



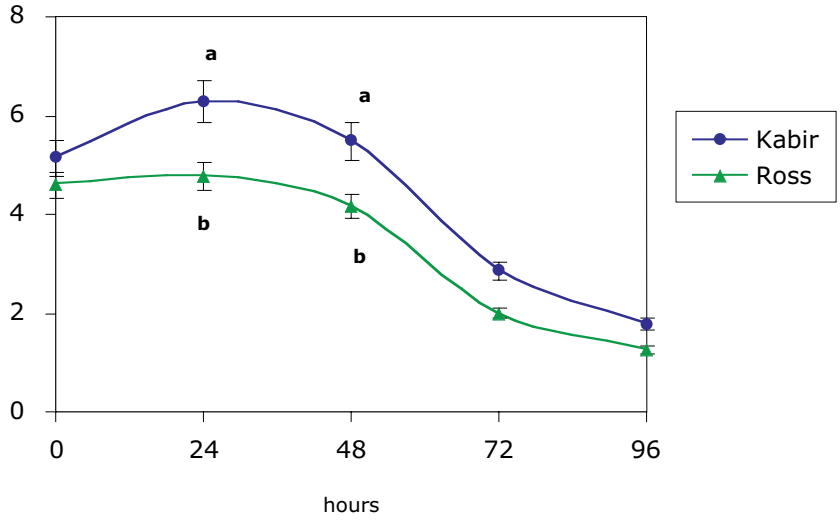
For each group and time n=20. a,b = P<0.05.

showed that the judges preferred the meat of Kabir birds until 48h of storage, during which the level of TBARS remained below 2 mg of malondialdehyde per kg of meat. Successively, meat acceptability decreased over time and the panellists were not able to discriminate the differences.

Initial and final juiciness was still correlated with the fat level and therefore the Ross meat had the best score.

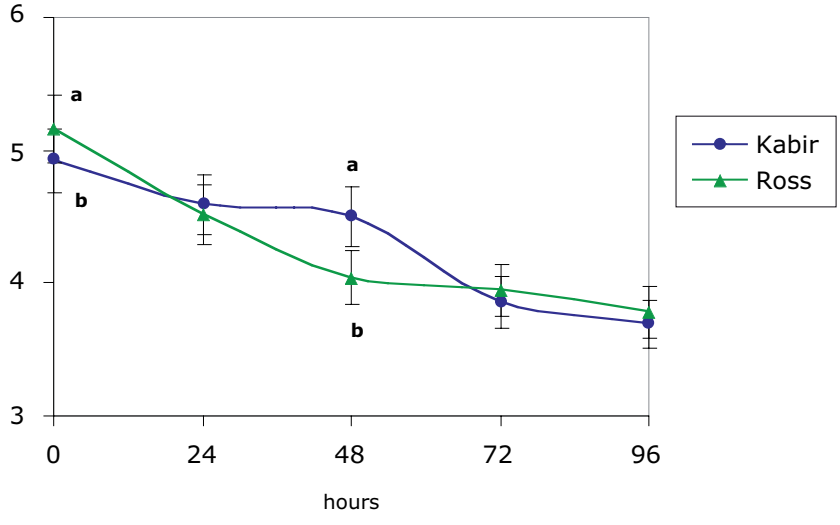
These observations are well supported by previous reports (Ahn *et al.*, 1996; Lei and Van Beek, 1997; Shahidi, 1998; Gomes *et al.*, 2003) where it has been also shown that TBARS play an important role in the sensory evaluation.

Figure 4. Evolution of a* value of chicken *Pectoralis major* muscle during display at 4°C under continuous fluorescent illumination.



For each group and time n=20. a,b = P<0.05.

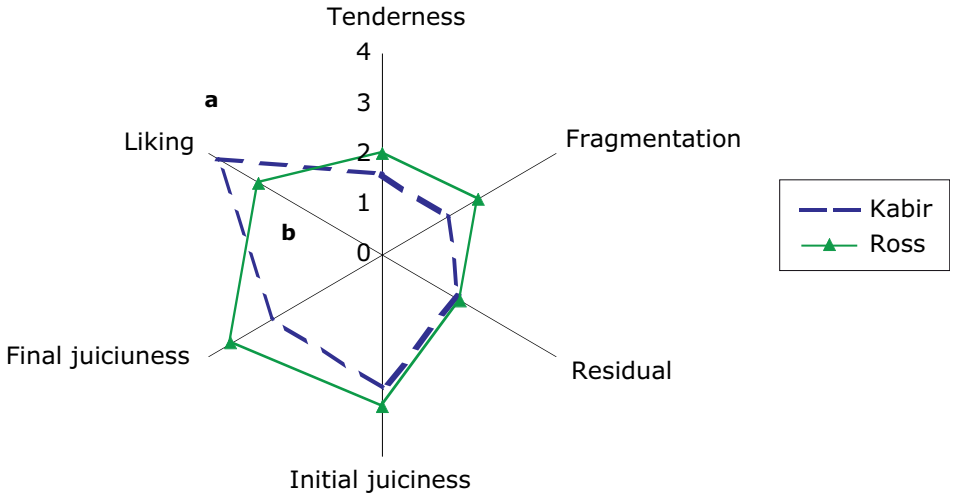
Figure 5. Post-mortem evolution of b* of chicken *Pectoralis major* muscle during display at 4°C under continuous fluorescent illumination .



For each group and time n=20. a,b = P<0.05.

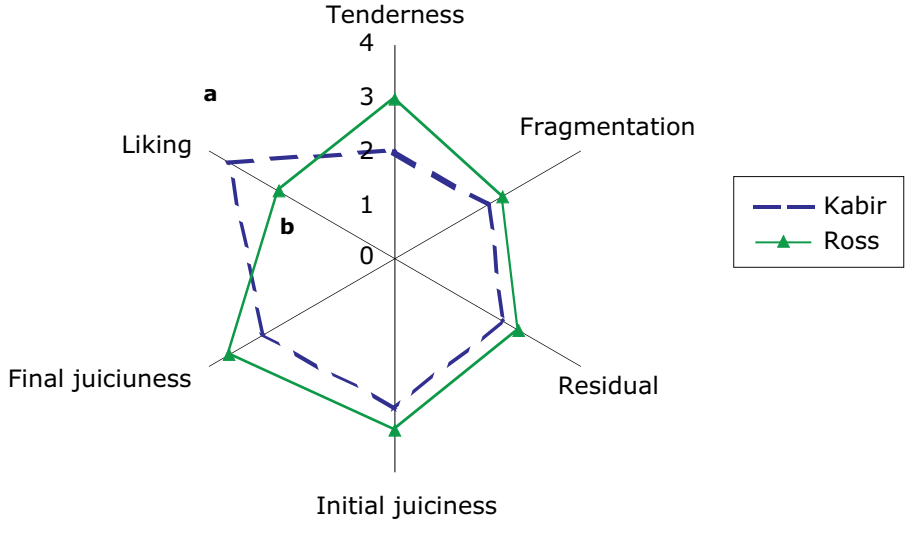
Figures 11 and 12 clearly show the very high negative correlation (respectively, –0.82 and –0.86; P<0.01; data not shown) between liking and TBARS. In Ross, with the worst oxidative status the liking score started to decrease at 24 hours, when the malondialdehyde level was greater than 2.5 mg kg^{-1} of meat. In Kabir, the decrease of liking score was relevant starting at 72 hours, with an amount of malondialdehyde analogous to that of Ross at 24 hours.

Figure 6. Sensory characteristics of chicken *Pectoralis major* muscle during display at 4°C under continuous fluorescent illumination (0 hours).



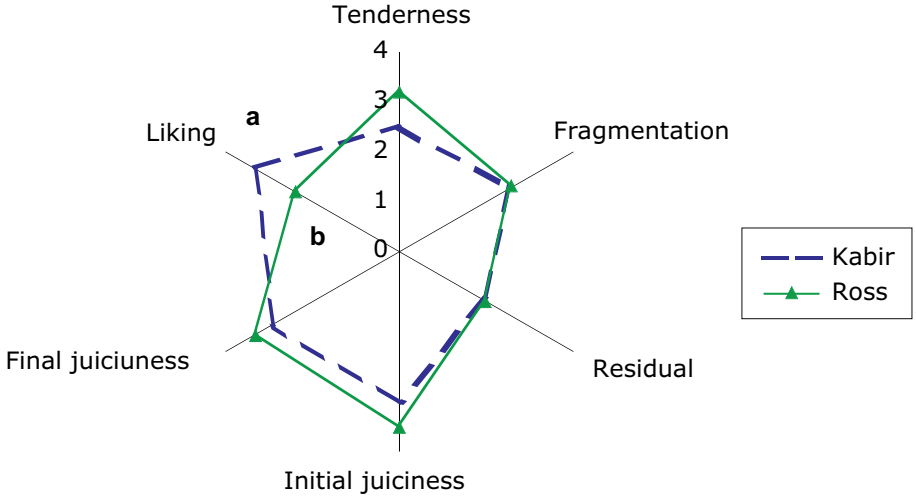
For each group n=9. a,b = P<0.05

Figure 7. Sensory characteristics of chicken *Pectoralis major* muscle during display at 4°C under continuous fluorescent illumination (24 hours).



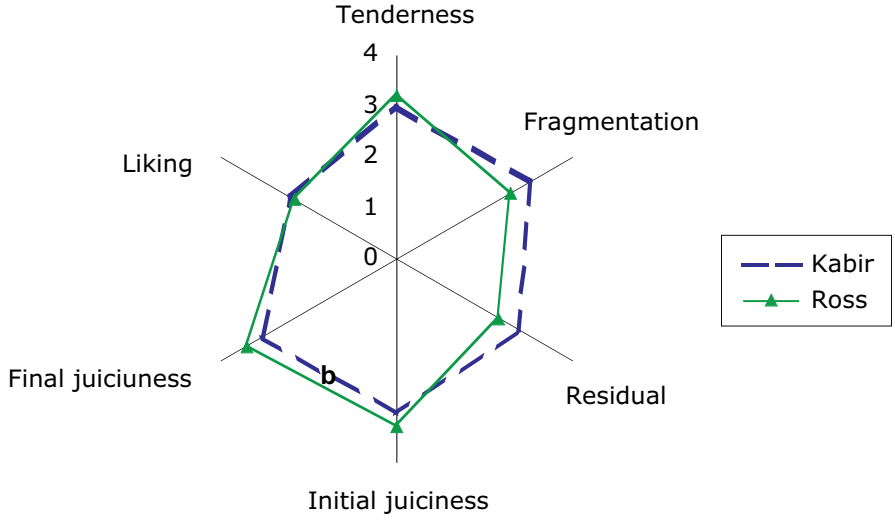
For each group n=9. a,b = P<0.05.

Figure 8. Sensory characteristics of chicken *Pectoralis major* muscle during display at 4°C under continuous fluorescent illumination (48 hours).



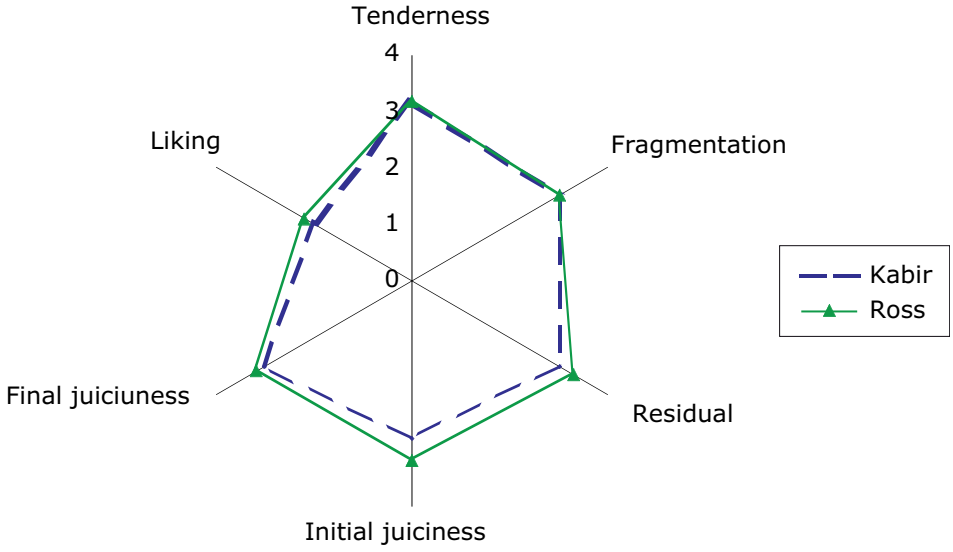
For each group n=9. a,b = P<0.05

Figure 9. Sensory characteristics of chicken *Pectoralis major* muscle during display at 4°C under continuous fluorescent illumination (72 hours).



For each group n=9.

Figure 10. Sensory characteristics of chicken *Pectoralis major* muscle during display at 4°C under continuous fluorescent illumination (96 hours).



For each group n=9.

Figure 11. Relationship between evolution of TBARS and liking in Kabir meat.

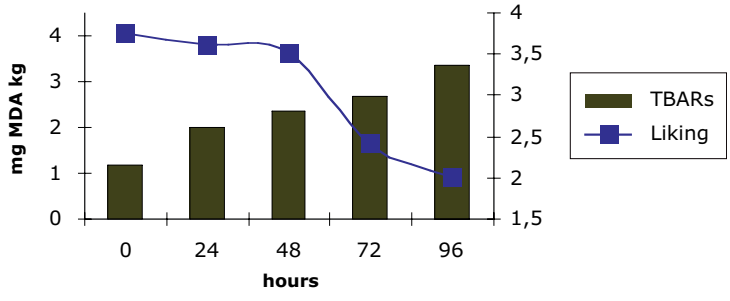
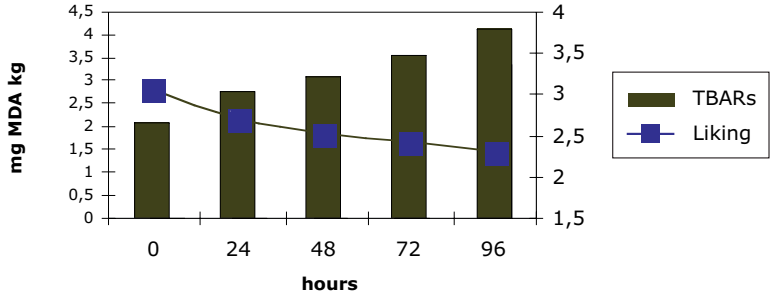


Figure 12. Relationship between evolution of TBARS and liking in Ross meat.



Conclusions

The organic system affects the meat characteristics in positive and negative ways: this system allows to obtain a leaner and tastier meat take obtained, but it contains a greater amount of free radicals and has a shorter *shelf-life*. The magnitude of these last negative characteristics appears modulated by the genotype; the higher kinetic activity and the uncontrolled environmental conditions contribute to worsening their oxidative status mainly in those strains selected for a fast growth rate.

Data also indicated that the pH_u value affects colour parameters and that the oxidative stability of the meat during storage depends by the initial oxidative status.

Furthermore the amount of TBARS showed a strong negative correlation with the sensory evaluation.

Considering the peculiar oxidative status of birds reared under organic conditions different strategies should be considered:

- avoid excessive carcass processing and reduce storage time;
- use strains more adapted to kinetic activity and poor environment conditions;
- provide more natural antioxidants such as grass or added to the feed.

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