EFFECT OF DIFFERENT STORAGE CONDITIONS ON LIPID OXIDATION IN BUFFALO MEAT.

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Background and Objectives - Buffaloes are a great source of milk products in many parts of the world but buffalo meat consumption is more limited; while in Asia and Middle East male buffaloes are utilised also for meat, in Italy, to avoid breeding costs, most of them are undersold at birth as buffalo meat is not familiar to a majority of italian consumers.
Some researches report that young buffalo meat characteristics are similar or superior to which of beef (Valin et al., 1984; Failla et al., 1997; Matassino et al., 1997;). Still little information is available on some quality determinants of buffalo meat, such as cooking/processing properties and storage stability of raw and cooked meat (Syed Ziauddin et al., 1993; Syed Ziauddin et al., 1994).
This study is part of a wider research work on buffalo meat quality which, besides the carcass characteristics and the chemical and physical properties of meat, includes also analysis of flavour and/or off-flavour in raw and cooked meat eventually related first to breeding and feeding conditions and then to product storages (Kanner et al., 1992). In the present research chemical composition and oxidative stability have been checked on young buffalo raw and cooked muscles after refrigerated or frozen storage.

Material and methods - Eight male Mediterranean buffaloes were fed, from birth (initial average live weight=50.3 kg) to six month age (≅190.6 days; final a. l. w.=221.6 kg) with skimmed milk powder (60% of milk at 23.2% of crude protein); daily quantities increased from about 0.7 to 2.6 kg of powder/head.
Meat quality analysis. All the animals were slaughtered at six months and carcasses were chilled at 4 °C for two days; at dissection the following parameters were determined in three muscles (*Gluteo biceps*, GB; *Longissimus dorsi*, LD; *Caput longum tricipitis brachii*, CLoTB): ultimate pH, dry matter (%) and crude fat percentage (% on DM); water losses in raw (by dripping) and cooked meat (in bath at 75°C for 50min.); colour, with C illuminant (lightness (L), red (a) and yellow (b) indexes, chroma (C) and hue (H)) using Macbet 1400 colorimeter apparatus and finally hardness in raw and cooked meat (kg/cm^2, Warner Bratzler Shear accessory, Instron 1011). Data were analysed with the following model: $y = \mu+\alpha_i+\varepsilon_{ij}$ where α_i = muscles(1,..,3).
Lipid oxidation. Samples of about 40 gr of the three muscles were immediately frozen at -60 °C (1) or stored at +4 °C for 10 days (2); at -20 °C for 30d (3) or 90 days (4) and then frozen at -60 °C. All samples were thawed at room temperature (23 °C) for an hour. Cooked samples ((5)+70 °C for 20 min.) were taken from thesis (1). Twenty grams of raw (≅7.36 of fat, table 1) or cooked ground samples were homogenized with 5% (w/v) of aqueous solution of trichloracetic acid (TCA) for 2 min; butylated hidroxytoluene (BHT, Sigma Chemical Co.) was added prior to homogenization; after centrifugation and filtration a 2 ml portion was reacted with 2 ml of 40 mM thiobarbituric acid (TBA, Sigma) in a water bath of 94 °C for 15 min; lectures of the absorbance values were effectued at 525 nm. Malonaldehyde standard solutions (from 0.5 to 10μM) were prepared by dissolving 1,1,3,3-tetramethoxypropane (Sigma) in 5% TCA.; to calculate the percentage of recovery fresh raw and cooked samples were extracted twice with TCA and then added and re-extracted with two pure malonaldehyde solutions (2 and 4μM); percentages of recovery resulted of 75.7 to 76.2 for raw and 76.3 to 78.1% for cooked meat with 2 and 4μM solutions respectively. Results were expressed as mg of malonaldehyde /kg of meat ((Raharjo et al.,1992; Raharjo and Sofos, 1993). Data were analysed with the following model with interactions: $y= \mu+\alpha_i+\beta_j+(\alpha_i\beta)+\varepsilon_{ij}$ where α_i= muscles(1,..3); β_j=storage conditions(1,...,5).

Results and Discussion - Mean values of pH, fat percentage and physical parameters of the three muscles are reported in Table 1. Ultimate pH values resulted slightly different among muscles (LD ≥ CLoTB ≥ GB, P≤ 0.05); ultimate higher ph values normally indicate lower cooked losses (LD ≤ CLoTB ≤ GB, P ≤ 0.05) and consequently good juiciness of meat (Guignot et al., 1994). Fat percentages were not significantly different among muscles; therefore fat contents were related to dry matter values (CLoTB ≥ LD > GB, P ≤ 0.05) and inversely related to raw meat hardness (LD < CLoTB ≤ GB, P ≤ 0.05).
Colour indexes (Table 1) resulted related to TBA values (Table 2): LD samples showed significant lower values of yellow (b), chroma and hue indexes and lower TBA numbers than the other two examined muscles (LD < CLoTB ≤ GB, P ≤ 0.05). In fact the lipid peroxidation processes are strictly correlated not only with flavour but also with colour stability of raw meat (Kanner et al., 1992).
The results indicate significant differences in TBA values (Table 2) due to length of freezing or frozen storage periods. Lower values of TBA numbers were calculated, for all the three muscles, at dissection (P ≤ 0.05) if compared with the other differently stored samples; similar values were recorded in the samples of the thesis (2), (4) and (5), whereas when the meat was maintened at -20°C for only 30d (3) oxidation was significantly lower but slightly high if compared to that of fresh meat (Syed Ziauddin et al., 1993)

Conclusions - It can be noticed that all found data were in the normal range of literature reported values for bovine calves fed with milk replacers and slaughtered at similar weights (Guignot et al., 1992; Guignot et al., 1994; Andrighetto et al., 1996); therefore an increase in buffalo meat

production would make a notable contribution for domestic and export purposes either as fresh or processed products (Syed Ziauddin et al., 1993; Syed Ziauddin et al., 1994).

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Table 1- pH, dry matter (%), fat percentage (% on DM) and physical quality parameters of muscle samples.

	pH	Dry	crude	Water loss		Colour					Hardness		
Muscles		Matter	fat	Raw	Cooked	L	a	b	Chroma	Hue	raw	cooked	N
CLoTB	5.61ab	23.71a	7.49	0.96	29.73ab	46.04b	18.11	15.02a	23.55a	39.80ab	3.17b	1.37	8
GB	5.57b	22.48b	6.68	1.09	30.32a	49.45a	17.32	15.82a	23.50a	42.57a	4.52a	1.67	8
LD	5.64a	23.58a	7.91	1.25	25.28b	44.33b	16.35	13.01b	20.93b	38.58b	2.77b	1.62	8
Means	5.60	23.25	7.36	1.10	28.44	46.61	17.26	14.62	22.66	40.32	3.49	1.55	24
RMSE	0.049.	0.788	2.180	0.482	4.734	3.104	1.787	0.991	1.566	3.369	0.713	0.339	24

RMSE: Root Mean Square Error. In columns, a, b: significant differences for P≤ 0.05.

Table 2- Effect of freezing and frozen different storage times on muscle TBA values.

Times (days)	At dissection	10d at +4°C	30d at -20°C	90d at -20°C	cooked	Means(*)	N
Muscles							
CLoTB	0.153b	0.268a	0.205ab	0.241a	0.233ab	0.220a	38
GB	0.129c	0.319a	0.222bc	0.274ab	0.305ab	0.250a	38
LD	0.138(b)	0.201(ab)	0.158(ab)	0.164(ab)	0.219(a)	0.176b	39
N	22	22	23	24	24	115	(RMSE)
Means	0.140c	0.263a	0.195b	0.226ab	0.253a	0.216	0.9485

In the rows a, b, c: significant differences for P≤ 0.05; (a), (b), for P≤ 0.10. (*):In the columns, a,b: significant for P≤ 0.05.