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Lipid oxidation in buffalo meat from animals with dietary supplementation of vitamin E

A. Cascone, A. Paduano, I. Battimo, R. Romano, V. Fogliano, R. Sacchi, L. Chianese

University of Naples, "Federico II", Dept. of Food Science, Via Università 100, I-80055 Portici (Na), Italy

Corresponding author: L. Chianese. Dept. of Food Science. University of Naples, Federico II, Via Università 100, I-80055 Portici, Naples, Italy - Email: lina.chianese@unina.it

ABSTRACT: Buffalo (*Bubalus bubalis*) meat is not widely used in the diet, but it is recently reconsidered due to its valuable nutritional qualities. New strategies aiming to improve the quality of buffalo meat have to be applied particularly to face the problem of lipid peroxidation, one of the most important causes of meat food deterioration. The aim of this study was to evaluate the lipid oxidation of buffalo meat (muscles *Caput longum tricipitis brachii*, *Longissimus dorsi* and *Semimembranosus*), coming from animals fed with two different amount of vitamin E (600 IU/die and 1500 IU/die for 102 -123 days) considering, as markers for lipid oxidation, the concentration of malondialdehyde (MDA) by *HPLC-UV* and *TBA* test. Moreover it was evaluated, by HPLC-DAD, vitamin E concentration in the meat samples. Muscles coming from animals with vitamin E supplementation were in mean 2 times more enriched of vitamin E than control ($p < 0.05$). Meat from buffalo fed with 600 IU/die vitamin E had significant lower MDA concentration in comparison with control (in mean -53%, n= 4). Both for MDA and vitamin E concentrations not significant differences were found between the supplementation of 600 IU/die and 1500 IU/die. It is concluded that dietary supplementation with Vitamin E is a promising strategy to prevent lipid oxidation of buffalo meat and to prolong its shelf-life.

Key words: Buffalo meat, Lipid oxidation, Vitamin E.

INTRODUCTION - Buffaloes are traditionally reared in Italy for their milk, used for the production of "buffalo mozzarella cheese". One of the factors for which most consumers judge buffalo meat to be unpleasant might be the autoxidation of fatty acids, particularly of unsaturated ones, that gives a number of volatile compounds which contribute to meat flavour (Elmore *et al*., 1999; Shahidi, 1998). Therefore the problem of lipid peroxidation in buffalo meat, one of the most important causes of meat deterioration and of organoleptic characteristic, should be face. Lipid oxidation produces free radicals that may be inactivated by Vitamin E, a lipid-soluble antioxidant, able to breaks the chain of lipid peroxidation in cell membranes and prevents the formation of lipid hydroperoxides (Halliwell, 1987; Davies, 1988). For this reason it has been found that Vitamin E supplementation can improve the quality of farm animal products. The aim of this research was to study the oxidation products of buffalo meat, monitoring the efficacy of vitamin E supplementation in buffalo diet. This was achieved by evaluation

of residual vitamin E concentration and lipid oxidation in the muscles of animals fed with different amount of vit E.

MATERIALS AND METHODS - The trial was performed on 12 buffalo calves that were 403 days old and had an average live weight of 333 kg. The animals were divided in 3 groups of 4 subjects: 1) 1500 I.U. of vitamin E/die; 2) 600 I.U. of vitamin E/die; 3) control. Buffaloes were controlled until the live weight for slaughter (426 kg) and received the same diet (mixed hay and concentrate 38%/62%) ad libitum. All buffalo calves were slaughtered between 102 and 123 days from the beginning of the trial. The carcases were kept at 8°C for four days after slaughter and processed and cut. They have been used samples of shoulder (*Caput longum tricipitis brachii)* (TB), loin (*Longissimus dorsi*) (LD) and buttock or rump (*Semimembranosus*) (SM) from buffalo (*Bubalus bubalis*) (Zicarelli *et al*., 2005). Meat was stored at -20 °C until using for vitamin E determination, for MDA determination samples were freeze dried and stored at -20 °C until using. For alpha-tocopherol detection, the method proposed by Lanari *et al*., (1994) was used with some modifications. For UV detection of MDA, the method proposed by Mateos *et al.,* (2004) with some modifications was used. For TBA test the method published by Maraschiello *et al*., (1999) was used. The results are expressed as means ± standard deviation of 4 samples coming from 4 animals. The value for every sample was the mean of triplicate determination . One way analysis of variance (ANOVA) followed by Tukey's test was used to contrast groups. The significance level was considered at $p < 0.05$. The relations between variables were analysed using Pearson correlation, with significance levels at $p< 0.01$ and $p< 0.05$. TheXL STAT ver. 6.1 (Addinsoft) software was used.

RESULTS AND CONCLUSIONS - Figure 1 shows that the concentration of vitamin E in the muscle LD is, for all samples (control, 600 IU,1500 IU), lower than in TB and SM. With regard to muscle tissue, several studies have demonstrated that the deposition of alpha-tocopherol is correlated to the dietary ingestion of this component and even varies as a function of the type of muscle (Lauridsen *et al.,* 2000; O'Sullivan *et al*., 1997). Jensen *et al*., (1988), reported a greater capacity of alpha-tocopherol accumulation in muscles with a higher oxidative metabolism. This might explain the greater quantity of this component found in the TB and SM muscles with respect to the LD. The latter is, in fact, composed primarily of white fibers, while the SM and TB are composed of a heterogeneous combination of glycolytic and oxidative fibers (Barone *et al*., 2005). Therefore, the concentration in the various tissues differs as a function of their metabolic type, which is in agreement with the results reported by Monahan *et al.* (1990) with respect to pigs. Also Lauridsen *et al*, 2000 found in pigs higher concentrations of alpha-tocopherol in the *psoas major* muscle (oxidative) compared with the *longissimus dorsi* (glycolytic) (Figure 1).
Concerning lipid oxidation level, animals that received the dietary supplement with 600 IU of vitamin E demonstrated lower concentration of MDA in the muscles (p=0.05) (data not shown). This result is in agreement with other authors (Lynch *et al*., 1999; *Mercier et al.*, 2004), in fact, as expected, antioxidants protected against lipid oxidation. Correlation between MDA by HPLC and TBA test by spectrophotometer method was +94% (Figure 2). Again, as for vitamin E concentration, it has been observed that there were not significant differences between the supplementation of 600 IU/die and 1500 IU/die both for MDA by HPLC and TBA test.

Results show that dietary supplementation with vitamin E influences the susceptibility of muscle lipid to undergo lipid oxidation reactions. As far as we know, this study reports for the first time information concerning dietary supplementation of vitamin E in buffalo suggesting that it affects lipid oxidation.
The alpha-tocopherol content in meat is positively correlated with the amount in enriched diet and negatively correlated with MDA values from lipid oxidation. It is concluded that diets enriched with 600 IU/buffalo die for about 100 days can be a successful strategy to

Figure 1. Vitamin E concentation in muscle. LD: *Longissimus dorsi*; TB: *Caput longum tricipitis brachii*; SM: *Semimembranosus*. Vitamin E concentration in µg / g fresh weight, evaluated by HPLC-DAD. Control: animal without vitamin E suplementation; 600: vitamin E supplementation 600 IU/die; 1500: vitamin E supplementation 1500 IU/die. Values are mean ± standard deviation; n = 3. Letters refer to differences with significance level at $p < 0.05$. Values followed by the same letter do not differ.

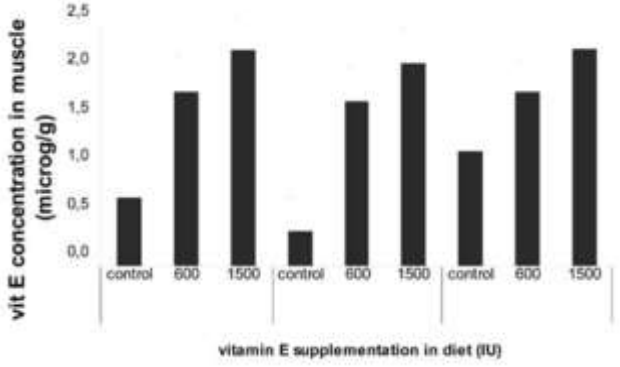
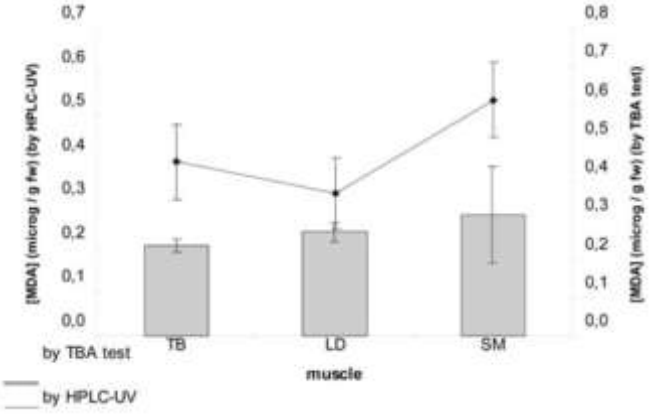


Figure 2. Correlation between the oxidation analysis with spectrophotometric and chromatographic method (HPLC/FD). LD: *Longissimus dorsi*; TB: *Caput longum tricipitis brachii*; SM: *Semimembranosus*. (results of 600 IU/ die samples). Values are mean ± standard deviation; n = 4.



inhibit the development of lipid oxidation and it is possible to suppose that vitamin E, preserving lipids, can influence positevely organoleptic characteristics prolonging the shelf-life of meat and, therefore, allowing a major diffusion of buffalo meat consumption.

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