Dietary antioxidant effect of vitamin E on different swine tissues

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ABSTRACT

Different types of tissues from swine fed with three contents of α tocopherol were analyzed in order to assess the anti-oxidant effect of the naturally occurring vitamin. In the work described, we evaluated the effects vitamin E supplementation administrated as α-tocopherol acetate in the following concentrations: 11 (C = control), 100 (E1), 300 (E2) mg/kg of diet and compared the findings with those of the basal diet group. The treatments affected the lipid stability of fresh muscle and different organs tissues during aerobic storage at refrigeration temperatures, supplementation reduced ($P<0.01$) lipid oxidation in E2 group compared with basal group (C), in accordance with the α -tocopherol contents of the diet.

Key words: vitamin E, antioxidants, lipid oxidation, swine

INTRODUCTION

Many factors affect pork quality, including genetics, preslaughter handling of the pig, and postslaughter handling of the carcass. An accumulating body of evidence shows that various nutritional factors affect pork quality (Pettigrew and Esnaola, 2001). The purpose of this review is to assemble and interpret the rapidly accumulating data concerning the impacts of swine nutrition on oxidative stability.

Animal requirements of vitamins have a dynamic character being dependent on the genotype, the level of performances and developing the production systems. (Svendsen, 2001). An optimum level of vitamins will influence the productivity, the maximum potential to obtain lean meat, a superior feed conversion, a good immune system status for the animal and as a consequence good organoleptic characteristics and a high nutritional value as far as pork meat is concerned.

The levels of vitamin E in the feed formulation used until now were at the level of nutritional requirements. Nowadays the level of vitamin E is not related

only to the aimed productivity performances but also to the quality parameters intended to be obtained.

Vitamin E offers supplemental benefits due its relationship with fat; vitamin E is stored in the fat tissue and after the animal was slaughter it remains active as antioxidant. This is the reason why vitamin E can reduce the rate of oxidation during meat shelf life (Yang et al., 2002).

MATERIALS AND METHODS

The biological material was represented by a number of 72 pigs of Large White Breed of average weight 59 kg divided into three groups of 24 pigs. The groups were randomly assigned a growing-finishing diet (Table 2) supplemented with the following levels of α-tocopherol acetate: 11 (C = control), 100 (E1), 300 (E2) mg/kg of diet.

Table 1: Experimental Design

Specification	**Group**		
	C	**E1**	**E2**
Number of tested animals	24	24	24
Period (Days) of feeding	41	41	41
Vitamin E in feed: mg/kg	11.0	100.0	300.0

The compound feed was administrated "ad-libitum" in two rations per day, the animals having permanent water access. The chemical composition of the feed is presented in table 2.

Table 2: Chemical composition of the compound feed

Ingredients	**%**
Corn	68.79
Full fat soy	9.00
Sunflower meal	6.00
Soybean meal (44%)	10.00
Choline mix	0.10
Lysine	0.25
Bone meal	4.46
Salt	0.40
Trace mineral mix and vitamin mix*	1.00

*Trace mineral mix and vitamin mix had content in vitamin E as follows: 1100 UI group C; 10 000 UI group E1 and 30 000 UI;

Sample collection

At the end of the experimental period two animals from each group were slaughtered and samples of liver, heart, loin and calf, Longissimus dorsi and fat were taken.

Samples were used to measure TBARS content at 4, 8 and 10 days post mortem (p.m.). All LD samples were subjected to triplicate analyses and were kept wrapped with PVC film and stored in the dark at 40C until 10 days p.m.

Lipid oxidation measurement

Lipid oxidation was assessed according to Lo Fiego et al., (2004). A sample of 10 g of muscle was homogenized, 30 s at high speed, with 25 ml of 20% trichloroacetic acid (TCA) and 20 ml distilled water. After centrifugation of the homogenate (1000g for 20 min at 4^{o}C), the supernatant was filtered through Whatman #1 filter paper. Two milliliters of filtrate was combined with 2 ml of 0.02 M aqueous 2-thiobarbituric acid solution (TBA), heated in a boiling water bath for 20 min together with a blank containing 2 ml of a TCA/water mix (1/1) and 2 ml TBA reagent and subsequently cooled in running tap water. The absorbance of the resulting solution was measured at 532 nm with a Helios Alpha spectrophotometer (Unicam - Thermo Electron) and the results expressed as absorbance values.

RESULTS AND DISCUSSIONS

The results in the tables 3 and 4 represent the mean values of the laboratory analysis for quality parameters of the samples from three batch formulation processes for the 3 experimental groups.

Table3: Quality parameters of the mixed feed as calculated values

Quality parameters	Calculated value
Crude Protein %	16.96
Net Energy (EM) Kcal /kg	3 227.0
Lysine %	0.91
Methionine + Cysteine %	0.58
Lipids %	5.0
Crude fiber %	4.31
Calcium %	1.03
Phosphorus %	0.85

Table 4: Quality parameters of the mixed feed as analysed values

Quality parameters	Analyzed
Crude Protein %	16.50
Crude fat %	4.91
Crude fiber %	4.48
Calcium %	1.21
Phosphorus %	0.74

Oxidation Stability

The absorbance of the resulting solution, prepared as described in the material and methods section, was measured at 532 nm with a Helios Alpha spectrophotometer and the results expressed as absorbance values.

The oxidative stability of liver, heart tissues and muscle LD as well as calf during storage was favourably affected by dietary vitamin E supplementation. Thus, TBARS development was reduced in the tissues of the E2 group compared to C.

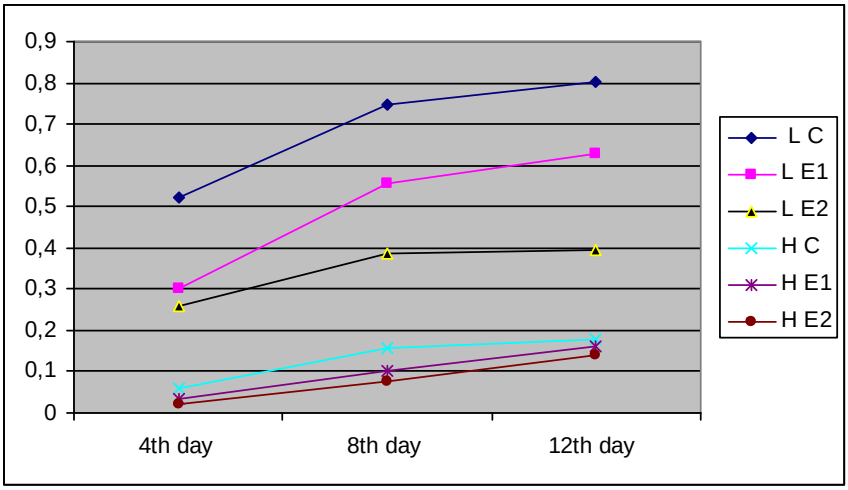

Figure 1 TBARS oxidation values in heart and liver tissues from the three groups

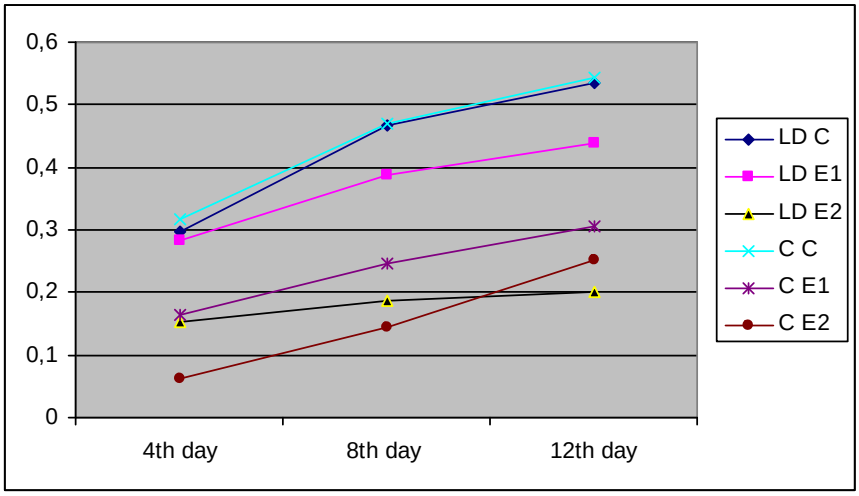

Figure 2 TBARS oxidation values in LD (Longissimus Dorsi) and calf tissues from the three groups

The liver samples had the highest oxidation rate (0,802 after 12 days of refrigeration storage) among all the tissues analysed including the muscular ones and calf, thought the LE2, liver samples from the E2 group were two times less oxidised compared with the control samples both after 4 days of refrigeration (LC = 0,523; LE2 = 0,260) and at the end of the of refrigeration storage (LC = 0,802; LE2 = 0,395). The lower oxidation values were exhibited by the heart tissue samples, where we could observe again the vitamin E effect on oxidation rate, 3 times lower TBARS values in HE2 (samples of heart tissue from the E2 group).

As far as LD (Longissimus dorsi) samples are concerned we noticed that the TBARS values were lower then the liver values and higher then the heart tissue value. When compared, the LD samples from the three groups, LD E2 exhibited the lower oxidation rate throughout all the storage period, being 1, 95 times lower then the LD C (Longissimus dorsi control samples) after 4 days and 2, 66 times lower after 12 days of refrigeration storage.

CONCLUSIONS

Lipid oxidation in refrigerated heart, liver, LD muscle and calf tissues was successfully reduced when coming from pigs fed a diet supplemented with 300 mg of a-tocopherol per kilogram of feed.

The liver samples had the highest oxidation rate after 12 days of refrigeration storage among all the tissues analysed including the muscular ones and calf, although the liver samples from the E2 group (LE2) were two times less oxidised compared with the control samples. The lower oxidation values were exhibited by the heart tissue samples, where we could observe again the vitamin E effect on oxidation rate, 3 times lower TBARS values in samples of heart tissue from the E2 group (HE2).

Longissimus dorsi samples had TBARS values lower then the liver values and higher then the heart tissue value, LD E2 exhibited the lower oxidation rate throughout all the storage period, being 1, 95 times lower then the LD C (Longissimus dorsi control samples) after 4 days and 2, 66 times lower after 12 days of refrigeration storage.

High levels of vitamin E supplementation (300 mg/ kg) in the last 41 days of heavy pig finishing reduced the production of thiobarbituric acid reactive substances (TBARS) which led to improved organoleptic characteristics. The TBARS reduction is was attributed to increased vitamin E levels in muscle.

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