Dietary vitamin E associated with plant polyphenols efficiently protects lipoperoxidation in pork chop and sausage in the finishing pigs

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Abstract – This study aimed to evaluate the impact of adding plant antioxidant (PA) into the finishing feed of pigs on the level of oxidation in pork chop and sausage during storage.
Forty hundred pigs received a standard diet with the same nutritional values. The diet for the test group was complemented with plant antioxidant for 2 months (2 kg/t feed).
In pork chop, lipid peroxidation from the control group increased during the period of refrigerated storage from 1 d to 12 d. While in the pork chop from the PA group, lower oxidation took place.
The sausage obtained from PA group exhibited an oxidative stability similar to sausage formulated with antioxidant additive. In conclusion, using PA in the feed of pigs could be a good alternative to guarantee quality and safety of pork meat. In addition it could prevent the use of chemical antioxidant during industrial processes.

Key Words – consumer, feed, natural antioxidant

I. INTRODUCTION

More and more consumers are concerned with the presence of synthetic chemicals in their daily food. Therefore the demand for natural, safe and organic food increases. On the other hand, the production of pigs with added nutritional value is increasing which brought new challenges to the meat industry. The use of plant antioxidant (PA) in pig diets reduces peroxidation of polyunsaturated fatty acids (PUFA) and preserves the sensory qualities of the PUFA n-3 enriched dry products like dry-cured ham [1]. We also showed in a previous study, that a short period of PA supplementation in animal feed was effective to protect pork meat and processed products against fatty acids peroxidation, when PUFA n-3 were incorporated in the diets [2, 3 & 4]. But the interest of PA incorporation on pig diets by itself on lipid peroxidation of pork meat and pork sausages during shelf life is still unknown.

II. MATERIALS AND METHODS

Two successive groups of 200 pigs castrated boars and female were raised under the same conditions on a commercial farm in Brittany, France. When reaching 65 kg of live weight they were divided into 2 homogenous groups Control (C) and Plant antioxidant (PA) respectively, (according with their sex and weight), until 118 ± 2.7 kg at slaughter time.
During this period, all the animals received a standard diet with the same nutritional values (9.9 MJ net energy and 13.7% proteins respectively per kg of feed). The feed of the PA batch was supplemented with 100 ppm of vitamin E associated with PA rich in polyphenols contained 8,6 ppm of equivalent gallic acid. The animals were slaughtered and the meat was processed in the same slaughterhouse in Brittany in two batches. The animals have followed the same conditions of fasting, transport and rest, before slaughter.
At 24h post slaughter, the pork meat was obtained (Muscle longissimus dorsi). Meat from the shoulders was ground to prepare sausages named “chipolatas”. The samples were packaged in modified atmosphere containing 65-75% of O_2 and 25-35% CO_2 and the chop pork were kept at 4°C for 1, 8 and 12 days then frozen at -18°C until analysis.

The ground meat of the two groups was divided in two parts: one was mixed with the currently mix of spices and conservative spices usually used to preserve the quality of the sausages and the other part was prepared without it. Then, the two preparations were stored at 4°C for 15 d before freezing at -18°C for analysis. Lipid oxidation of pork chop and sausage was carried out on C and PA group (n=10 for each group of pork chop; n= 12 for sausage) using the ThioBarbituric Acid Reactive Substances (TBARS) method according to the method of Lynch and Frei [5]. TBARS concentrations were calculated using 1,1,3,3-tetraethoxypropane (0−0.8 µM) as standard and expressed as milligrams of malondialdehyde (MDA) per kilogram of meat (TBA units).

Data are expressed as means ± SD. Statistical analyses were performed using Statistica. A two ways ANOVA was performed (time and diet). When statistical significance was reached by ANOVA ($p < 0.05$), the Tukey test was applied for *post hoc* analysis.

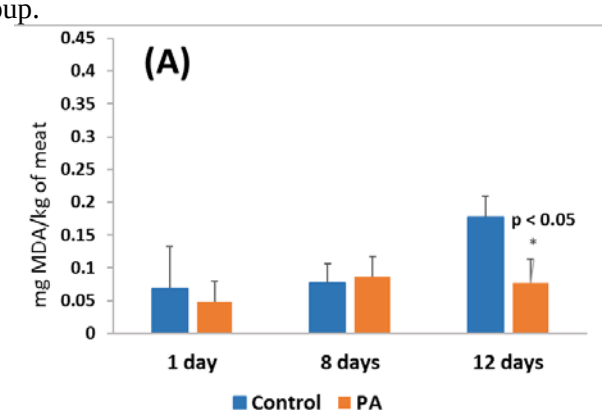
III. RESULTS AND DISCUSSION

The effect of dietary treatment on MDA values in pork chop during storage are shown on figure 1. We observed a strong batch effect on lipid oxidation. The MDA values are higher for all the pork chops from the 2nd batch. After one day of storage, MDA values of pork chop from pigs fed the control group and the PA group was affected by the slaughter time. The MDA values were lower for the PA group in comparison to the control group.

The reduced oxidation of pork chop samples from pigs fed the PA diet was significantly lower at the end of storage whatever the batches considered (0.077 and 0.117 mg MDA/kg of meat respectively for batch 1 and 2). Meanwhile, the lipid oxidation continues to increase in the control group.

The values of MDA are lower in the sausage prepared from PA group than in those from control. Values of MDA (Figure 2) found in the sausage prepared from pigs from the control group without adding spices during industrial process are significantly higher ($p< 0.05$) than those from pigs fed PA supplemented diet. Moreover, the lipid oxidation exhibited in PA group is comparable or lower to that obtained in the meat with added spices during the industrial process.

Lipid oxidation in sausage from control group was higher than from PA groupe. Regarding the MDA contents of the control, a maximun value of 5.2 mg/kg was obtained on the minced meat without the mix of additives against 2.3 mg/kg in PA group.



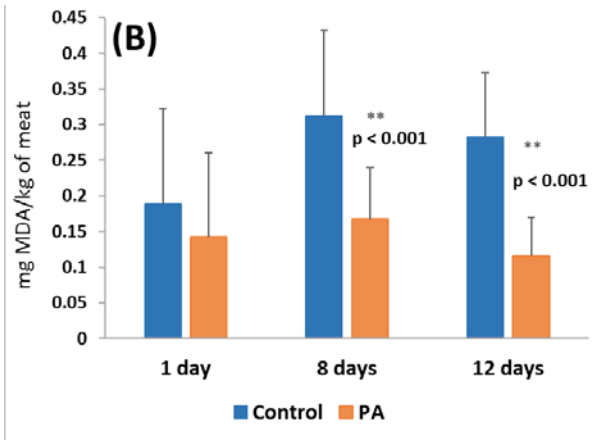


Figure 1 MDA values (mg/kg meat) developed during the storage (1 to 12 d) of pork chop from pigs fed on a basal diet with no supplemented antioxidants (control) or supplemented with PA (n = 10). (A) Animals from 1st batch ; (B) Animals from 2nd batch

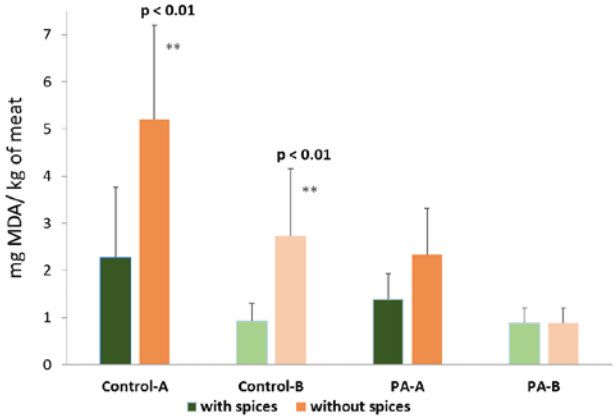


Figure 2 Lipid peroxidation (MDA mg/kg) from sausage storage (15 d) from porcs fed on a basal diet with no supplemented antioxidants (control) or a diet containing 2 kg/t PA (n = 12). (A) Animals 1st slaughtered ; (B) Animals 2nd slaughtered.

Verma and Sahoo [6] indicated a MDA concentration between 1 and 2 mg/kg as a threshold value for rancidity, while Green and Cumuze [7] considered a MDA range of 0,6-2 mg/kg to be the minimum detectable level for oxidised flavour in ground beef by an inexperienced panel. Accordingly, the control sausage might be perceived as rancid. However, in a previous study [4] we have observed that levels of MDA as higher as 3.6 mg/kg in sausages was well accepted by the tasters in a hedonic-type tasting. Therefor we should be cautious comparing the level of oxidation between different food-producing species.

Today the food industry often use antioxydants during the industrial process to preserve the meat quality. Shimada et al., [8] showed that a tomato powder additive (2%) to the uncured cooked pork sausages has the same antioxidative benefits as 0.1% BHT indicating a very strong antioxidative effect.

In our study, we can observe that the addition of PA directly in the feed of fattening pigs allows to limit lipid peroxidation in pork and processed products at a similar level as the mix of additives spices during industrial process. To the best of our knowledge, they are no reports on the use of natural plant antioxydant in pig diet showing similar efficiency to preservatives added in industrial processes on lipid oxidation.

IV. CONCLUSION

Adding PA in the finishing fattening diet of pigs is efficient to reduce peroxidation on pork and processed products and to improve the shelf life of the products. Moreover, as the lipid peroxidation of PA group is as efficient as that obtained by some preservatives used in the meat industry, this can help to open up new opportunities for the meat sector and give to the consumers both convenience and trust before purchasing meat pork in their local grocery store.

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