

# EVOLUTION OF THE FATTY ACID COMPOSITION OF DRIED SAUSAGE DURING DRYING ACCORDING TO THE N-3 FATTY ACID CONTENT AND THE DURATION OF PLANT ANTIOXIDANT DISTRIBUTION IN THE PIG FEED

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**Abstract - The production of pigs with added nutritional value because of n-3 fatty acids in the meat continues to spread. So it is important to protect these n-3 fatty acids from peroxidation by the addition of antioxidants. During this study we compared the effect on the pork of adding an antioxidant with extruded linseed, a source of n-3 fatty acids, by modulating the durations of antioxidant distribution. We monitored how the composition of the fatty acids in the sausage evolved during drying. In animals not receiving n-3 fatty acids in their diet, peroxidation is low over time. In pigs receiving linseed, it is higher. It appears that it is not necessary to provide plant antioxidants in the diet throughout the time when there are inputs of n-3 fatty acids, and that a short period of time before slaughter is sufficient.**

**Key-words: fatty acids, peroxidation, antioxidant, sausage, plant extracts**

## I. INTRODUCTION

The incorporation of linseed, which is a source of C18:3 n-3 ( $\alpha$ -linolenic acid), into pig feed makes it possible significantly to increase the content of these fatty acids (FA) (1). The nutritional value of these consumer products is increased by the presence of these n-3 fatty acids considered to be good for health and by a reduction in saturated fatty acids (2). These fatty acids have to be protected from peroxidation. The addition of vitamin E and plant extracts (PA) to feed reduces the risk of peroxidation of the polyunsaturated fatty acids and preserves the sensory qualities of the AG n-3 enriched dry products (3). The PAs (very often polyphenols) regenerate the action of vitamin E (4). In a previous study, we showed

that it is unnecessary to add PAs for a long period of time (the whole duration of linseed distribution); a shorter period of time is as effective to protect the fatty acids in the pork from peroxidation (5). How will the fatty acid peroxidation evolve during the meat processing process? This will be the objective of this study. The fatty acid composition will be analyzed during the drying process of pork sausages from animals receiving more or less n-3 fatty acids or antioxidants.

## II. MATERIALS AND METHODS

32 castrated male pigs, divided into 4 batches of 8, received from 50 kg live weight and for a period of 2 months, either an identical diet enriched with n-3 fatty acid *via* the introduction of extruded linseed (Tradi-Lin®), or a control diet containing palm oil as the fatty matter. The overall lipid content of the diets containing linseed was 3.6% providing 7.5 g of C18:3 n-3 (ALA)/kg of feed and 80 ppm of vitamin E. One batch received this diet without any PA inputs (batch PA0). Another batch received this diet supplemented with PAs (2kg/tonne of feed; batch PA2). The last batch received diet PA0 for a period of 50 days then a diet containing PAs (4kg/tonne) during the last 10 days before slaughter (batch PA4). The control diet (CON) contained 3.5% of total lipids and the same content of vitamin E as the PA diets. The animals in individual housing were fed *ad libitum*; their feed consumption was recorded and they were weighed weekly. At slaughter, fat tissue and lean shoulder meat were taken to make sausages. The weight composition of the mixture is shown in table 1. Drying lasted for 12 weeks.

The total lipids and the fatty acids composition were analyzed on the mixture, on sausages sampled every 15 days and on the finished

product. The measurement of the TBARs was carried out on the first day on the mixture and on the end product.

**Table 1** Preparation of the mixture used for making the dried sausages

Batch	PA0	PA2	PA4	CON
Lean shoulder	80%	80%	80%	80%
Hard fat	20%	20%	20%	20%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>
Salt	30 g/kg	30 g/kg	30 g/kg	30 g/kg
Potassium nitrate	0.3g/kg	0.3g/kg	0.3g/kg	0.3g/kg
Dextrose	10g/kg	10g/kg	10g/kg	10g/kg
Bovail garlic pulp	4g/kg	4g/kg	4g/kg	4g/kg
Red wine	4g/kg	4g/kg	4g/kg	4g/kg
White pepper	3g/kg	3g /kg	3 /kg	3g /kg
Mixed ferment (1)	1 bag/200kg	1 bag/200kg	1 bag/200kg	1 bag/200kg
Ferment surface (2)	1bag/50 L	1bag/50 L	1bag/50 L	1bag/50 L

- (1) LYOFLORE 2M TEXEL *Lactobacillus saké* + *Staphylococcus carnosus*
  - (2) *Penicillium naelgiovensis* PNT1 NG8 TEXEL
- Natural casing: beef middle casing 50/60 MM

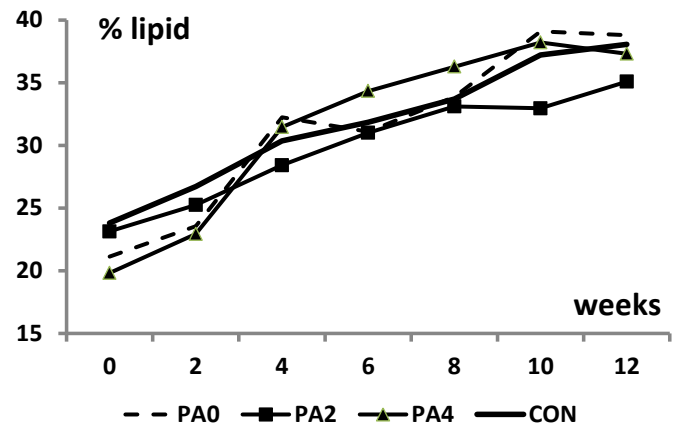
The results were tested by global analysis of variance with the diet effect as principal factor, and then they were compared two by two using the Bonferonni test.

### III. RESULTS AND DISCUSSION

The pigs' food consumption and growth performances are identical between the diets.

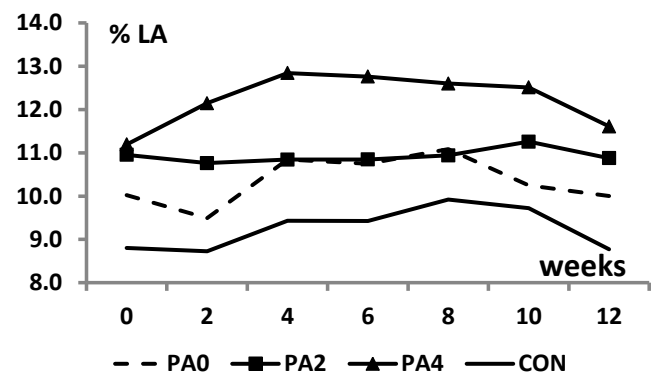
When the sausages are being made, the pH before drying is 5.62 for batch PA0; 5.81 for PA2; 5.67 for PA4; 5.73 for CON. After 57 h of drying, the pHs are respectively 5.25; 5.25; 5.19; 5.25. The values of the pHs are therefore identical to each other.

The total lipid contents of the mixtures vary from 19.8 to 23.8%, with no significant effect. During drying, the lipid content increases in the sausages and the variations are not significantly different from each other at the same stage of time (Figure 1).



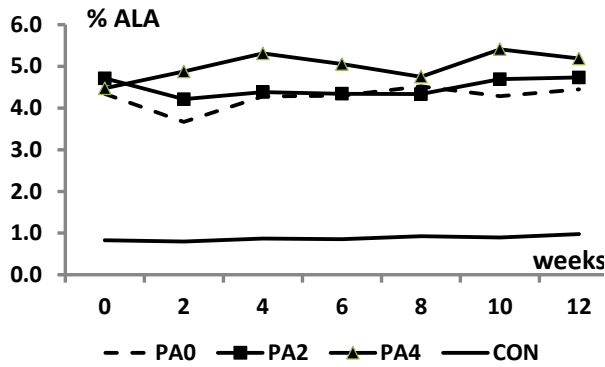
**Figure 1** Evolution of the lipid content of the sausages according to the drying time

The fatty acid composition of the mixtures varies in relation to the animals' diet (6). The percentage of n-3 fatty acids is greatly increased in the three PA batches compared to the control batch ( $p < 0.001$ ). The same applies for the C18:2 n-6 ( $p < 0.01$ ) which is higher in the PA batches. Identical observations are noted for the fatty acids of the end product. Over time, the percentage of C18:2 n-6 remains higher in the PA batches compared to the control batch (Figure 2).

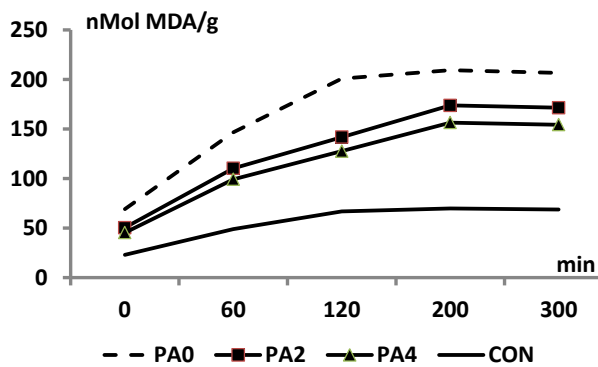


**Figure 2** Evolution of C18:2 n-6 sausages according to the drying time

There is little variation in the C18:3 n-3 percentage during drying according to each product. As it remains stable, it can be supposed that it does not disappear because of peroxidation phenomena (Figure 3).



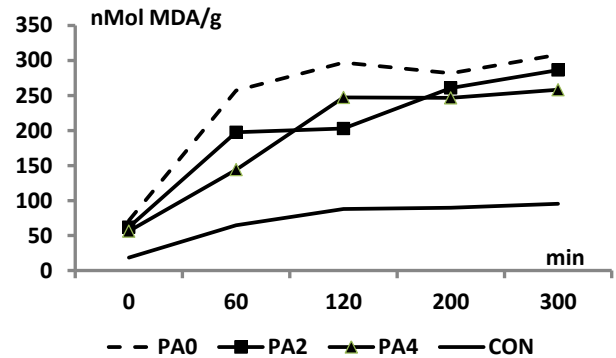
**Figure 3** Evolution of the C18: 3 n-3 sausages according to the drying time



**Figure 4** Comparison of the TBARs values of the mixture according to the animals' diets

The TBARs values are not very high in the mixture for the control batch. They are significantly higher for the PA batches ( $p < 0.001$ ) (Figure 4). A two by two average comparison shows a significant difference between batch PA0 and PA4 where the peroxidation is lower in the batch with PA and this as of 120 minutes of incubation.

After 12 weeks of drying, the peroxidation of the fatty acids is higher than before drying for all the PA batches whereas it does not vary significantly for the control batch (figure 5). The TBARs values are the highest for the batch without PA. Batch PA4 is significantly different from PA0 but not from PA2. It thus appears that the introduction of plant antioxidants into the diet a few days before slaughter together with a source of n-3 fatty acids makes it possible to have the same effectiveness of protection with respect to polyunsaturated fatty acids as a distribution of this antioxidant throughout the whole of the diet with n-3. This approach will make it possible to reduce the production costs of pigs in this linseed sector.



**Figure 5** Comparison of the TBARs values of the sausages according to the animals' diets

A hedonic-type tasting of the product after drying satisfied the tasters at the organoleptic level. No sausage was rejected even if the malondialdehyde content appears higher in sausages from the batches with n-3 fatty acids.

#### IV. CONCLUSION

The interest of adding PAs together with the polyunsaturated fatty acids of the diet to reduce risks of peroxidation is verified. The protective effect highlighted on fresh products is confirmed on products with short drying times (12 weeks). The supplementation of feed with PAs for a short period of time seems sufficient to obtain an effect on the protection of polyunsaturated fatty acids. This is of economic interest for the production of pork enriched with n-3 fatty acids.

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