INFLUENCE OF DIETARY VITAMIN E SUPPLEMENTATION ON FATTY ACID PROFILES OF THE MEAT AND COOKED HAM.

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Background

Some meat have implications on the dietary causes of cardiovascular chronic diseases due to their high content of saturated fatty acids (Maattson and Grundy, 1985). The depotted fat composition of monogastric meat animals shows the highest content of monounsaturated fatty acids (oleic acid), wich has decreased the cholesterol (Jialal and Fuller, 1996). However, unsaturated lipids are particularly susceptible to oxidation, during meat processing and storage (Labuza, 1971). One way to increase the oxidative stability of lipids and cholesterol in foods is to increase the amount of natural antioxidants such as α-tocoppherol (vitamin E) or β-carotene in the diet. Feeding diets supplemented with vitamin E applied to animals like chickens, cows, and pigs resulted in vitamin accumulation in the animal muscle and better oxidative stability under prooxidative condition, such as storage and cooking (Jensen, Lauridsen and Bertelsen, 1998)

Objectives

Demonstrate that feeding diets supplemented with vitamin E can kept the fatty acid profile during cooked ham processing and storing, without incorporating of flavor or taste.

Methods

Sixteen crossbred pigs (*Large white X Landrace X Pietran*), eight barrows and eight gilts were randomly alloted to one of the four treatment groups: 1) control diet containing no supplementary vitamin E, 2) diet formulated to contain 100 mg of vitamin E/kg diet, 3) 200 mg of vitamin E/kg diet, 4) 400 mg of vitamin E/kg diet. The diets were supplemented with vitamin E in the form of α-tocopherol (Rovimix 50%®, Hoffmann-LaRoche, nutley, NJ – USA). The feeding period was completed in 116 days, and, then, the pigs were immediately slaughtered. After the chilling period, the *biceps femoris* muscles were removed from the carcass to produce the cooked hams. Before the cooked ham processing, the *biceps femoris* samples were taken and stored at -20ºC for the analysis. The cooked ham was produced in an industrial unit, and were stored at at 5ºC during 2 months to be analysed. The *biceps femoris* samples were thawed and homogenated with blender. The extration and determination of total lipids were undertaken according to Folch, Less and Stanley's method (1957). The lipid classes fatty acid analysis was determined by gas chromatographic separation and quantification. Prior to the chromatography, the lipids were transesterified to methyl esters according to Hartman and Lago's method (1989). A total of 36 saturated, nonounsaturated and polyunsaturated fatty acid standards (Sigma and Polyscince, USA) were used. The cooked ham samples fatty acids profile was analysed as described above at 0, 30 and 60 storing days. The statistical significance of the difference between the fatty acids profile in *biceps femoris muscle* and cooked ham was determinad by ANOVA. The difference significance among the averages was determined by Tukey test. The fatty acids profile statistical analysis of the cooked ham considering treatments and sex during 60 days period (0, 30 and 60 days) was tested in a split-plot design (Gomes,1985). The whole plot variables included treatments and sex. Time was the split plot variable. All data were analyzed using the SAS General Linear Model procedure (1999). The multiple comparision tests were performed by Tukey ($P < 0.05$). The cooked ham sensory analysis aimed to find off flavor provoked by the vitamin E addition to the pigs diet (Cipolli, Souza and Silva, 2000). The 30 days storaged cooked ham samples were analysed using a ranking test.

Results and Discussions

The different processing steps did not affect the fatty acid composition, and the vitamin E supplementation different levels in the diet did not influence either. Lauridsen, Nielsen, Henckel and Sorensen (1999) did not observed significant differences in the fatty acid composition of *psoas mayor* muscle of swines that had received different levels of vitamin E supplementation in their diets. The fatty acid content average observed in the different treatments was: 1.6% C14:0; 23.3% C16:0; 3.3% C16:1n7; 9.7% C18:0; 47.2% C18:1n9; 10.1% C18:2n6; 2.3% C18:3n3; 0.22% C20:0; 0.38% C20:2n6 and 0.17% C20:4n6, therefore, very close values to the ones observed in this research. However, Onibi, Scaife, Murray and Fowler (1998) observed a reduction in saturated fatty acid and polyunsaturated amount, and an increase in the monounsaturated amount, when compared to the *longissimus dorsi* swine fatty acid contents, fed with control diet and the ones fed with diet supplemented with 200 mg of vitamin E/kg diet. Bragagnolo and Rodriguez-Amaya (1997), using the same extraction and determination techniques on fatty acid, observed the following profile for samples of swine meat: 0.2 ± 0.1% C10:0; 0.3 ± 0.1% C12:0; 2.3 ± 0.7% C14:0; 24.1 ± 1.2% C16:0; 3.0 ± 0.4% C16:1n7; 9.6 ± 0.8% C18:0; 38.8 ± 3.4% C18:1n9; 13.0 ± 2.4% C18:2n6; 0.5 ± 0.2% C18:3n3; 0.5 ± 0.1% C18:4n3; 0.10 ± 0,02% C20:2n6 and 2.1 ± 0.6% C20:4n6. The observed values are very close to the ones in this study, justifying the differences between breed (Wood and Lister, 1973), feed (Grundy and Denke, 1990), climate (Fuller, Duncan and Boyne, 1974), sex (Terrel, Swess and Bray, 1969) or sampling. Concerning sex, oleic acid contents (C18:1n9) had a significant difference ($P < 0.05$) in the samples of ham (meat), and, consequently, in the samples of cooked ham. The barrows exhibited higher values than those presented by the gilts, 49.0 ± 0.8% and 45.2 ± 0.7%, respectively.

Table 1 shows the averages obtained in the cooked ham fatty acid contents treatments during the 60 shelf life days under refrigeration.

In the first 30 storaging days, a significant difference was not observed ($P > 0.05$) among the fatty acid contents. However, by the end of 60 storaging days, in control and 100 mg vitamin E/kg feed treatments, a significant reduction in the contents C18:1n9. C16:1n7, C18:3n3 and C18:4n3 was observed; and an increase in the contents C16:0, C18:0, C20:0, C10:0, C12:0, C14:0, C15:0 and C20:4n6. As a result, we can observe a significant increase ($P < 0.05$) in the ΣSA and ΣPUFA, with a reduction in the ΣMUFA. Since the pork is considered one of the biggest sources of C18:1n9, a monounsaturated fatty acid that influences in the reduction of the cholesterol levels, this maintenance has been considered of very nutritional importance (Heyden, 1994). The cooked ham fatty acid composition in swines that received diets supplemented with 200 and 400 mg of vitamin E/kg, did not present significant differences ($P > 0.05$) during the shelf life in all samples.

It was not observed a significant difference ($P > 0.05$) among the total lipid contents in the cooked ham, presenting an average of 1.91 ± 0.04%, a value inferior to the one observed by Bragagnolo and Rodriguez-Amaya (1997), 3.5 ± 1.4% in ham and 2.4 ± 0.8% in swine loin. Even the lower percentages in the lipid contents confirm the increasing tendency of "light swine" (Albuquerque, 1995).

The ham sensorial analysis showed that the different levels of vitamin E supplementation did not cause significant differences in the texture characteristics, odor and flavor (Cipolli, Souza and Silva, 2000).

Conclusion

The supplementation with vitamin E at the same level or superior to 200 mg/kg diet, supplied during the 116 days before slaughter, kept the fatty acid profile of the cooked ham unchangeable during 60 cold storing days, assuring one of the biggest sources of fatty acid C18:1n9 without incorporating off flavor or taste.

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Table 1: Effect of storage on the fat acid profile(%) of cooked ham[a]

FAT	Control			100 mg/fed Vitamin E			200 mg/fed Vitamin E			400 mg/fed Vitamin E		
AC(%)	0 days	30 days	60 days	0 days	30 days	60 days	0 days	30 days	60 days	0 days	30 days	60 days
C10:0	0.09[b]	0.09[b]	0.15[a]	0.10[a]	0.10[a]	0.13[a]	0.11[a]	0.10[a]	0.11[a]	0.11[a]	0.11[a]	0.10[a]
C12:0	0.07[b]	0.07[b]	0.13[a]	0.08[a]	0.08[a]	0.10[a]	0.08[a]	0.07[a]	0.07[a]	0.08[a]	0.06[a]	0.07[a]
C14:0	1.21[b]	1.13[b]	1.78[a]	1.32[b]	1.19[b]	1.57[a]	1.20[a]	1.23[a]	1.16[a]	1.15[a]	1.17[a]	1.20[a]
C15:0	0.98[b]	1.00[b]	1.89[a]	1.12[b]	1.08[b]	1.54[a]	0.96[a]	1.00[a]	0.90[a]	0.91[a]	0.89[a]	0.90[a]
C16:0	23.51[b]	23.37[b]	25.78[a]	22.97[b]	23.02[b]	25.53[a]	23.64[a]	24.06[a]	23.98[a]	23.95[a]	23.34[a]	23.43[a]
C16:1n7	3.28[a]	3.38[a]	1.23[b]	3.26[a]	3.33[a]	1.89[b]	3.28[a]	3.63[a]	3.27[a]	3.39[a]	3.67[a]	3.28[a]
C18:0	12.03[b]	12.17[b]	14.20[a]	11.89[b]	11.48[b]	13.07[a]	12.48[a]	11.47[a]	12.07[a]	11.95[a]	12.20[a]	11.75[a]
C18:1n9	46.84[a]	46.38[a]	38.15[b]	46.87[a]	47.01[a]	39.97[b]	46.03[a]	45.98[a]	45.62[a]	45.58[a]	46.12[a]	47.00[a]
C18:2n6	9.04[b]	9.37[b]	11.41[a]	9.32[b]	9.34[b]	11.23[a]	9.07[a]	8.97[a]	9.31[a]	9.51[a]	9.03[a]	8.83[a]
C20:0	0.11[b]	0.12[b]	2.37[a]	0.15[b]	0.16[b]	1.67[a]	0.54[a]	0.59[a]	0.63[a]	0.60[a]	0.65[a]	0.65[a]
C18:3n3	0.57[a]	0.63[a]	0.13[b]	0.61[a]	0.64[a]	0.47[b]	0.98[a]	1.20[a]	1.17[a]	1.08[a]	1.13[a]	1.16[a]
C18:4n3	0.98[a]	0.96[a]	0.23[b]	0.97[a]	1.03[a]	0.34[b]	0.10[a]	0.08[a]	0.09[a]	0.09[a]	0.09[a]	0.10[a]
C20:2n6	0.10[a]	0.09[a]	0.08[a]	0.11[a]	0.12[a]	0.09[a]	0.11[a]	0.09[a]	0.10[a]	0.10[a]	0.09[a]	0.11[a]
C20:4n6	1.19[b]	1.24[b]	2.47[a]	1.23[b]	1.33[b]	2.40[a]	1.42[a]	1.53[a]	1.52[a]	1.50[a]	1.45[a]	1.42[a]
ΣSA[b]	38.00[b]	37.95[b]	46.30[a]	37.63[b]	37.21[b]	43.61[a]	38.57[a]	38.52[a]	38.92[a]	38.75[a]	38.42[a]	38.10[a]
ΣMUFA[c]	50.12[a]	49.76[a]	39.38[b]	50.13[a]	50.34[a]	41.86[b]	49.31[a]	49.61[a]	48.89[a]	48.97[a]	49.79[a]	50.28[a]
ΣPUFA[d]	11.88[b]	12.29[b]	14.32[a]	12.32[b]	12.46[b]	14.53[a]	12.12[a]	11.79[a]	12.19[a]	12.28[a]	11.79[a]	11.62[a]
PUFA/SA[e]	0.31[a]	0.32[a]	0.31[a]	0.33[a]	0.33[a]	0.32[a]	0.31[a]	0.30[a]	0.31[a]	0.31[a]	0.30[a]	0.30[a]
T.L.(%)[f]	1.90[a]	1.95[a]	1.95[a]	1.90[a]	1.85[a]	1.90[a]	1.85[a]	1.85[a]	1.90[a]	1.90[a]	1.85[a]	1.85[a]

[a] Averages obtained among the four treatments, 2 sexes (barrows ans gilts) and true repetitions; [b]ΣSA = Total saturated fat acids; [c]ΣMUFA = Total monounsaturated fat acid; [d]ΣPUFA = Total polyunsaturated fat acid; [e]PUFA/SA = Rate between total polyunsaturated fat acids and total saturated fat acids; [f]T.L. (%) = Total Lipids.
Different letters in the same row are significantly different ($P < 0.05$).