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The effect of α- and γ-tocopherol on lipid oxidation and lipid stability of meat in broiler chickens

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INTRODUCTION

α-tocopherol

- antioxidant activity, used as a supplement
- NRC recommendations: 10 IU (10 mg α-tocopherol acetate = 6.7 mg RRR-α-tocopherol)

γ-tocopherol

- antiinflammatory activity, important in immune processes
- abundant in feed
- activity → 10 % as α-tocopherol

→ Synergy??? ←

MATERIALS AND METHODS

46 one day old broilers → 5 experimental groups

Table 1 : Fat and vitamin E supplementation of the experimental diets

GROUP		SOURCE OF FAT	VITAMIN E SUPPLEMENTATION
Cont-	(N=10)	5% PALM FAT	10 mg α-tocopherol acetate/kg
Cont+	(N=10)	5% LINSEED OIL	10 mg α-tocopherol acetate/kg
α	(N=10)		67 mg RRR-α-tocopherol/kg
γ	(N=8)		67 mg RRR-γ-tocopherol/kg
α+γ	(N=8)		33.5 mg RRR-α-tocopherol + 33.5 mg RRR-γ-tocopherol/kg

ANALYSES:

- Oxidative stress *in vivo* → lymphocyte DNA damage, plasma malondialdehyde (MDA), ferric reducing capacity (FRAP), antioxidant capacity of lipid soluble compounds (ACL)
- Plasma, breast and thigh muscle vitamin E concentrations
- Lipid stability of meat → MDA in breast and thigh muscles stored under different conditions:
  - fresh
  - 6 days at 4°C
  - 2 months at -20 °C
  - 4 months at -20 °C

RESULTS

Table 2: Effect of dietary α- and γ-tocopherol on lymphocyte DNA damage (OTM), plasma malondialdehyde concentration (MDA), ferric reducing capacity (FRAP) and antioxidant capacity of lipid soluble compounds (ACL)

	Cont-	Cont+	α	γ	α+γ	Significance	SEM
OTM	3.16[ab]	4.41[b]	2.92[a]	2.83[a]	2.88[a]	*	0.35
MDA (nmol/ml)	0.28[a]	0.73[c]	0.50[b]	0.73[c]	0.48[b]	***	0.06
FRAP (nmol/ml)	685.3[a]	679.9[a]	908.0[b]	650.9[a]	779.7[ab]	**	55.0
ACL (nmol/ml)	118.9[a]	125.2[a]	163.8[b]	125.6[a]	151.0[ab]	***	11.1

[abc] Least square means within a line with unlike superscripts differ significantly ($P < 0.05$).
[1]OTM Olive Tail Moment (the product of the amount of DNA in the tail and the mean distance of migration in the tail)

Table 3: Effect of dietary α- and γ-tocopherol on concentrations of α- and γ- tocopherol in plasma, breast and thigh muscles

		Cont-	Cont+	α	γ	α+γ	Significance	SEM
Plasma	α-tocopherol	8.19[a]	5.79[a]	39.85[c]	3.62[a]	19.91[b]	***	1.80
(μg/ml)	γ-tocopherol	0.50[a]	0.29[a]	0.31[a]	1.05[b]	1.07[b]	***	0.08
Breast	α-tocopherol	3.06[a]	3.50[a]	14.92[c]	1.95[a]	7.38[b]	***	0.67
(μg/g)	γ-tocopherol	0.24[a]	0.21[a]	0.26[a]	1.00[c]	0.85[b]	***	0.04
Thigh	α-tocopherol	9.94[a]	13.48[a]	48.89[c]	6.79[a]	26.29[b]	***	2.33
(μg/g)	γ-tocopherol	0.84[a]	0.93[a]	0.88[a]	3.46[b]	3.06[b]	***	0.13

[abc] Least square means within a line with unlike superscripts differ significantly ($P < 0.05$).

CONCLUSIONS

- High levels of polyunsaturated fatty acids → ↑ lipid oxidation
- The retention of vitamin E → α-tocopherol > γ-tocopherol
- Lipid oxidation → ↓ in α-tocopherol, but not in γ-tocopherol supplemented group
- DNA damage was prevented in all supplemented groups.
- The combination of both antioxidants showed some synergistic effects.

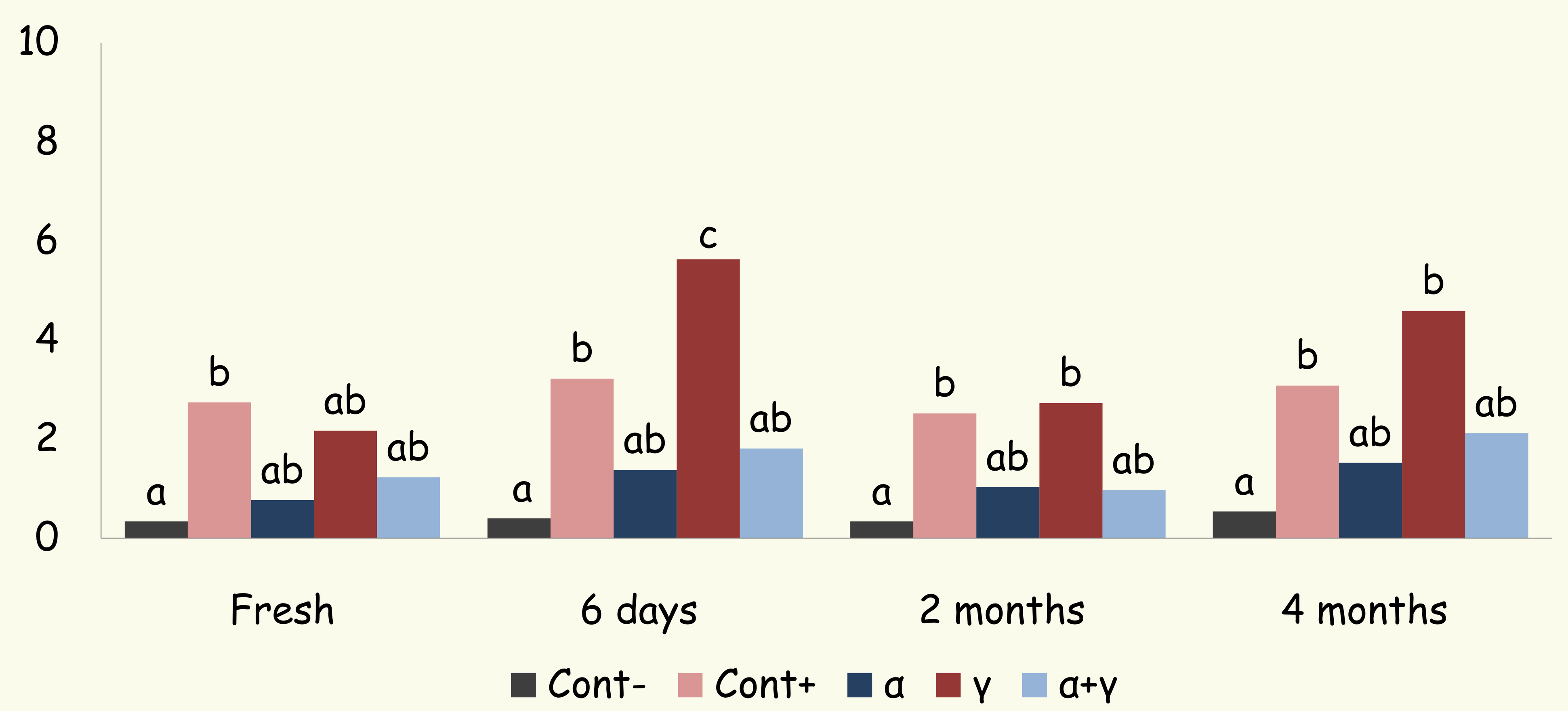

Figure 1: Effect of dietary α- and γ-tocopherol on malondialdehyde concentration (nmol/g) in breast muscle under different storage conditions

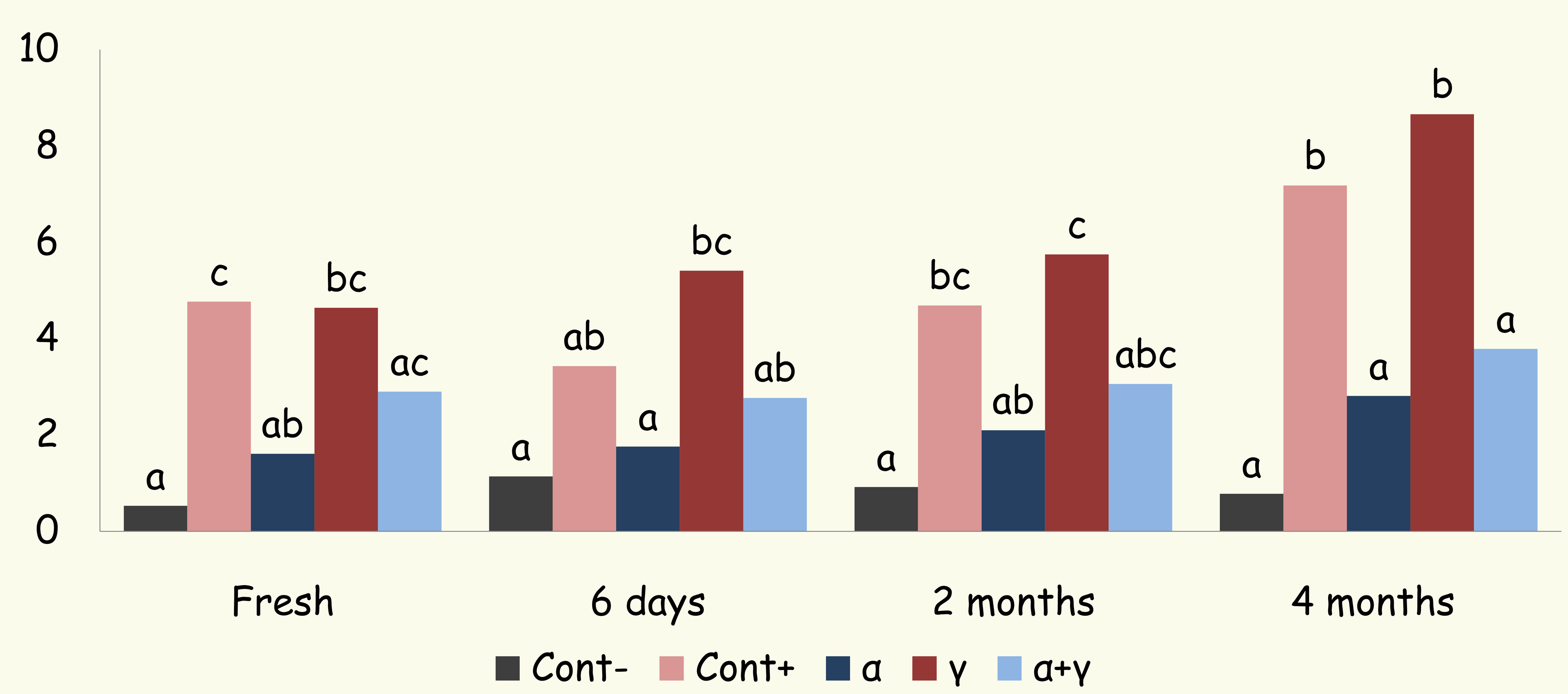

Figure 2: Effect of dietary α- and γ-tocopherol on malondialdehyde concentration (nmol/g) in thigh muscle under different storage conditions