EFFECT OF DIETARY FISH OIL, AND α-TOCOPHERYL ACETATE AND Zn SUPPLEMENTATION ON COMPOSITION AND ACCEPTABILITY OF CHICKEN MEAT

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OBJECTIVES AND EXPERIMENTAL DESIGN

Objectives

The main objective of this work is to assess the possibility of obtaining raw chicken meat enriched in n-3 polyunsaturated fatty acids (PUFA), α-tocopherol, and Zn. In addition, we tested to determine whether this cooked dark chicken meat shows good oxidative stability and sensory acceptability.

Experimental Design

A 2x2x2 factorial design was planned to study the effect of various dietary factors: two doses of α-tocopheryl acetate (α-TA) supplementation (70 and 140 mg/kg), two doses of Zn supplementation (0 and 200 mg/kg), and two doses of fish oil (1.25% and 2.5%). Total added fat was completed up to 6% with animal fat.

Diets and Animals

One-day-old female broiler chicks were fed on different diets for 6 weeks. α-TA supplementation and Zn supplementation were supplied throughout the period; the doses of fish oil (FO) were supplied from the third to the sixth week.

Preparation, Cooking and Storage of Samples

After 6 weeks chickens were slaughtered according to commercial procedures. Legs and breasts with skin from each treatment were divided into two groups. In the first group, an equal number of legs and breasts from each treatment were hand-deboned, ground, vacuum packed and immediately stored at -20ºC for chemical analysis of raw chicken meat (α-tocopherol and Zn content, and fatty acid composition). In the second group, only legs from each treatment were hand-deboned, vacuum-packed and immediately cooked in an oven at 85ºC (99% of relative humidity) reaching an internal temperature of 80ºC. These samples were then stored at -20ºC until sensory and 2-thiobarbituric acid (TBA) analysis.

METHODS

- Determination of α-tocopherol in mixed dark and white raw chicken meat was carried out by reverse-phase HPLC as described by Grau *et al.* (2000b).
- Determination of fatty acid composition in mixed dark and white raw chicken meat was carried out by GC as described by Bou *et al.* (2001).
- Determination of Zn. To determine Zn, sample mineralization of mixed dark and white raw chicken meat was conducted in open vessels first using nitric acid and then perchloric acid. An inductively coupled plasma atomic emission spectrometer was used for Zn quantification.
- Sensory analysis. Two consumer panel tests were carried out (immediately after cooking and after 5 months of frozen storage). Acceptability of cooked dark chicken meat samples was rated using a 9-point scale.
- Determination of TBA values. Cooked dark chicken meat samples were analysed as described by Grau *et al.* (2000a).

RESULTS

- **α-Tocopherol Content.** α-TA supplementation increased the α-tocopherol content (Figure 1). Therefore, mixed dark and white raw chicken meat from treatments supplemented with 140 mg/kg of α-TA covered a 26% of the Recommended Dietary Allowances (Food Nutrition Board, 2000), while meat from treatments supplemented with 70 mg/kg of α-TA covered only a 19% of these recommendations (Figure 4). On the other hand, the FO dose affected the α-tocopherol content. Thus, meat from the 2.5% fish oil diet showed a decrease in α-tocopherol content compared with the 1.25% dose (Figure 1). Zn supplementation did not affect the α-tocopherol content (Figure 1).
- **Zn Content.** The Zn content of meat was not affected by Zn supplementation or by the rest of the factors assayed.
- **Fatty Acid Composition.** The fatty acid composition of meat was only affected by the FO dose. An increase in PUFA content of feeds, three weeks before slaughter, led to an increase of these fatty acids in meat (2.5% *vs.* 1.25% of FO). However, the ratio unsaturated/saturated fatty acids did not change, since the MUFA content was lower in the meat from the 2.5% fish oil treatment (Table 1). Regarding eicosapentaenoic acid and docosahexaenoic acid content in the meat, we observed that the 2.5% FO diet gave close to 2-fold the value found at the 1.25% dose (Table 1). Therefore, the efficiency of deposition seemed to be proportional to the fish oil content of the diets at the assessed doses. Thus, meats obtained from these dietary treatments can be considered a good source of long-chain n-3 PUFA (Figure 4). Neither α-TA supplementation nor Zn supplementation affected the fatty acid composition of meat (Table 1).
- **Sensory and TBA Analysis.** Acceptability of meat samples showed no significant differences among dietary treatments and none from a freshly cooked sample (used as blind control) for both storage times, i.e., immediately after cooking and after 5 months of frozen storage (Figure 2). These results are in agreement with TBA values which did not show significant differences among treatments (Figure 3).

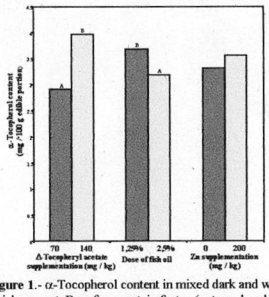

Figure 1.- α-Tocopherol content in mixed dark and white raw chicken meat. Bars for a certain factor (α-tocopheryl acetate, fish oil or Zn supplementation) bearing no common letters are statistically different at $P \leq 0.05$.

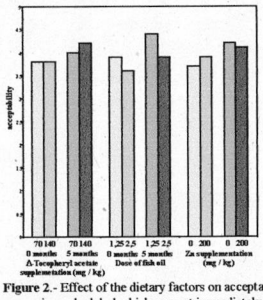

Figure 2.- Effect of the dietary factors on acceptability scores in cooked dark chicken meat immediately after cooking and after 5 months of frozen storage. Mean of the acceptability of the blind control was 4.7.

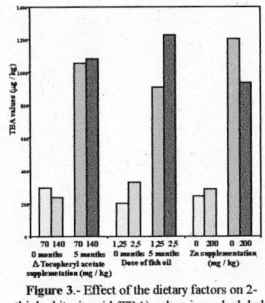

Figure 3.- Effect of the dietary factors on 2-thiobarbituric acid (TBA) values in cooked dark chicken meat immediately after cooking and after 5 months of frozen storage.

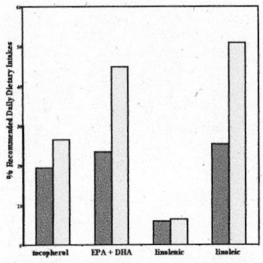

Figure 4.- Percentage of the human recommended daily dietary intakes provided by 100 g of edible portion (Food Nutrition Board, 2000; Simopoulos *et al.*, 2000).

Table 1.- Fatty acid composition of the experimental feeds and the effect of the dietary factors on the fatty acid composition of chicken meat (expressed as area normalization in %). Means corresponding to a certain factor bearing distinct superscripts differ significantly at $P \leq 0.05$.

Fatty acids	Feed			Mixed dark and white raw chicken meat					
	Until 3 weeks of age	From 3 to 6 weeks of age		Dose of fish oil (%)		α-Tocopheryl acetate supplementation (mg/kg)		Zn supplementation (mg/kg)	
		fish oil 1.25%	fish oil 2.5%	1.25	2.5	70	140	0	200
Total SFA	32.01	36.33	34.64	32.47	32.63	32.48	32.61	32.58	32.51
Total MUFA	35.90	39.61	38.36	51.28 ^{a}	49.34 ^{b}	50.32	50.30	50.32	50.30
C18:2 n-6	26.0	18.36	17.67	12.37	12.43	12.45	12.36	12.35	12.46
C18:3 n-6	0.02	0.04	0.04	0.11	0.10	0.11	0.10	0.10	0.11
C20:2 n-6	0.23	0.23	0.23	0.18	0.19	0.18	0.19	0.18	0.19
C20:3 n-6	0.08	0.08	0.08	0.17	0.16	0.17	0.16	0.17	0.16
C20:4 n-6	0.19	0.28	0.34	0.38 ^{a}	0.48 ^{b}	0.44	0.43	0.44	0.43
C22:4 n-6	0.06	0.17	0.28	0.09	0.08	0.09	0.08	0.09	0.08
C22:5 n-6	ND	0.06	0.10	0.03	0.04	0.04	0.04	0.04	0.04
Total n-6 PUFA	26.58	19.21	18.73	13.33	13.51	13.48	13.36	13.37	13.47
C18:3 n-3	5.28	1.70	1.79	1.08 ^{a}	1.16 ^{b}	1.12	1.12	1.11	1.12
C18:4 n-3	0.01	0.45	0.94	0.19 ^{a}	0.36 ^{b}	0.27	0.28	0.27	0.28
C20:4 n-3	ND	0.14	0.24	0.07 ^{a}	0.12 ^{b}	0.09	0.10	0.09	0.09
C20:5 n-3	0.06	1.01	2.11	0.48 ^{a}	0.94 ^{b}	0.71	0.71	0.71	0.71
C22:5 n-3	ND	0.06	0.10	0.33 ^{a}	0.53 ^{b}	0.43	0.43	0.43	0.42
C22:6 n-3	0.09	1.38	2.9	0.76 ^{a}	1.43 ^{b}	1.10	1.09	1.10	1.08
Total n-3 PUFA	5.51	4.85	8.27	2.91 ^{a}	4.52 ^{b}	3.72	3.72	3.73	3.71
Total PUFA	32.09	24.06	27.00	16.24 ^{a}	18.03 ^{b}	17.20	17.08	17.10	17.18
Total MUFA + PUFA	67.99	63.67	65.36	67.53	67.37	67.52	67.38	67.42	67.48
(MUFA + PUFA)/SFA	2.12	1.75	1.89	2.08	2.07	2.08	2.07	2.07	2.08

ND: not detected

CONCLUSIONS

- Chicken meat from broilers fed treatments supplemented with FO and α-TA were good dietary sources of long-chain n-3 PUFA and α-tocopherol (Figure 4).
- Zn supplementation for six weeks at the dose assayed (200 mg/kg) did not affect the content of this mineral in meat.
- Acceptability of samples, immediately after cooking and after 5 months of frozen storage, was not different among dietary treatments and none from a freshly cooked sample.

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