FATTY ACID COMPOSITION AND CHEMICAL PROPERTIES OF CHICKEN FRANKFURTERS AS AFFECTED BY DIETARY FISH OIL AND STORAGE TIME

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SUMMARY

Chicken frankfurters were made from chickens whose feed was supplemented with three levels (0, 2 and 4%) of codfish oil. The frankfurters were vacuum packaged and stored at 0°C for 0, 10, 20 and 30 days. The total anaerobic plate counts, TBA values and pH values of chicken frankfurters were not affected ($P>0.05$) by the levels of fish oil in the diets. However, pH values of frankfurters decreased ($P<0.05$) as storage time increased. The TBA values for all chicken frankfurters remained very low (≤0.36) during 30 days storage. Chicken frankfurters from chicken fed diets with 2 and 4 % supplemental fish oil had higher levels of N-3 fatty acids, especially for EPA and DHA; and had lower levels of N-6 fatty acids. Supplementation of 2 and 4 % fish oil in diets did not effect the quality of chicken frankfurters during storage based on TBA values and overall fish flavor scores.

INTRODUCTION

Omega N-3 fatty acids in marine fish products had been reported to prevent certain diseases, especially cardiovascular disease. Hulan et al. (1988) reported that broiler chickens fed a diet containing 5.0% fish meal have substantial amounts of EPA (20:5), DHA (22:6) and other N-3 polyunsaturated fatty acids, deposited in the carcass and edible meat lipids and N-3 fatty acids were significantly increased by feeding higher levels of red fish meal (15 or 30%) or red fish oil (2 or 4%). Huang (1996) reported that a fishy flavor in chicken leg meat had been noted for treatments with 2 or 4% of supplemental cod fish oil. The TBA values for chicken skin increased with dietary supplementation of cod fish oil. Chicken legs from treatments with supplemental cod fish oil (2 or 4%) had higher TBA values and lower overall acceptability scores than those of the controls (0 % fish oil).

The objective of this research was to use chicken breast meat from chickens fed with supplemental cod fish oil (0, 2, or 4%) to manufactured chicken frankfurters and to study the effect of dietary fish oil and storage time (0, 10, 20 and 30 days) on fatty acid composition, cholesterol content, TBA values and total anaerobic plate counts of chicken frankfurters.

MATERIALS AND METHODS

The formulation for chicken frankfurters contained less than 20% fat and 30% added water. Chicken breast and chicken skin were from chickens (Arbor Acre, average initial wt. was 40.4 g) fed diets with 0, 2 or 4% supplemental fish oil for the 6 weeks growing period. Frankfurters were vacuum packaged and stored 30 days in the dark at 0°C for further product evaluation.

The pH values were determined on the same samples used for the total anaerobic plate counts. Fatty acids were identified by comparison of retention times to know standards. Relative quantities of fatty acids were expressed as g of weight per 100 g of total fatty acids in each sample. Eicosapentaenoic (EPA, 20:5; N-3) and docosahexaenoic acid (DHA, 22:6; N-3) were also expressed as mg per 100 g meat (Lin et al., 1995).

The procedure described by Lin and Kuo (1995) was used to determine the content of cholesterol by gas chromatography (Shimadzu GC14A, Columbia, MD) with a 30 m × 0.32 mm fused silica capillary column (J&W Scientific, Folsom, CA, U.S.A.). Temperatures were: injection port, 300°C ; detector, 315°C; and column, 285°C . N_2 was the carrier gas with the flow rate of 6.0 mL/sec.

The method described by Ockerman (1985) was used to determine 2-thiobarbituric acid (TBA) values. A 10-member, experienced (average 0f 6 years) panel was used to determine the fishy flavor scores of frankfurters at 0 and 10 days of storage(1=extremely strong fishy flavor; 9=no fishy flavor).

RESULTS AND DISCUSSIONS

The pH values (Table 1) were not different ($p>0.05$) for chicken frankfurters from chicken supplemented with fish oil (2 or 4%) as compared to those from chicken fed the control diet. However, a significant storage effect was noted for pH values which tented to decrease as storage time increased. This was likely due to the growth of lactic acid bacteria in vacuum packaged chicken frankfurters during storage.

Over the entire storage period, TBA values , in general, were lower for controls than for 2% fish oil or 4% fish oil treatments. The differences in TBA values between controls and 2% fish oil treatment or 4% fish oil treatment at 20 days and 30 days were significant ($p<0.05$). Due to the high % of unsaturated fatty acid in the fish oil used, these results were espected. There was a general increase in TBA values with the 30 days storage period, but all values remained below 0.4 TBA, regardless of dietary treatment with fish oil or storage time, suggesting little oxidative rancidity problems in these products. The relatively low extent of lipid oxidation probably could be attributed to vacuum packaging which removed most of the oxygen from packaging or low fat content (less than 20 %). Ockerman and Kuo (1982) reported that the use of vacuum packaging is a good means of reducing lipid oxidation in dried pork.

Changes in fatty acid composition (Table 2) and specifically increases in eicosapentaenoic acid (EPA, 20:5) and docosahexaenoic acid (DHA, 22:6) were observed in chicken frankfurters as a response to increased dietary fish oil supplementation. Other notable changes in the fatty acid composition included increased in stearic acid (18:0) and myristic acid (14:0) and corresponding declines in linoleic acid (18:2). In addition to fish oil, composition of the basal diet for broiler in this research also included 4-7% fish meal over the 6 wk growing period. Therefore, the controls (0% fish oil) also contained EPA and DHA. The N-3 fatty acid content of frankfurters increased ($P<0.05$) with dietary supplementation of fish oil fed to chicken, but N-6 fatty acid content decrease ($P<0.05$) as the supplemental fish oil increased. Cod fish oil supplementation (2 or 4%) increased ($P<0.05$) the content of EPA and DHA in fresh chicken breast meat and fresh chicken skin (Table 3). Chicken frankfurters made from chicken fed diets with 2 and 4% supplemented fish oil also had elevated ($P<0.05$) the content of EPA (119 mg/100 g and 246 mg/100 g, respectively) and DHA (118 mg/100 g and 186 mg/100 g, respectively). The differences in EPA or DHA content between controls and 2% fish oil treatment or 4% fish oil treatment were significant ($P<0.05$).

Chicken frankfurters were subjected to sensory evaluation at 0 days and 10 days storage. No significant ($P>0.05$) storage effect was found for the fishy flavor scores which tented to slightly decrease as storage time increased to 10 days (Fig.1). Supplemented fish oil (2 or 4%) in the diets did not adversely affected the fishy scores of chicken frankfurters. However, Huang (1996) indicated that the fishy flavor in fresh chicken leg had been noted where higher levels of supplemental oil were fed. The flavor of fresh chicken leg was adversely affected based on the sensory panel. From these results, the content of N-3 fatty acid could be increased in chicken frankfurters by supplementing fish oil to diets without affecting sensory properties.

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Table 1. The pH and TBA values for chicken frankfurters from chicken supplemented with fish oil

Fish oil (%) in diets	pH				TBA			
	0	10	20	30 (days)	0	10	20	30 (days)
0	6.62aA	6.39aB	6.28aC	6.18aD	0.23aA	0.18bA	0.19bA	0.22bA
2	6.53aA	6.49aAB	6.24aB	6.17aC	0.21aB	0.19bB	0.33aA	0.36aA
4	6.52aA	6.51aA	6.35aB	6.34aB	0.24aB	0.28aAB	0.34aA	0.35aA

[a,b] Means in the same column with different letters are significantly different ($P<0.05$).
[A-D] Means in the same row for pH or TBA values with different letters are significantly different ($P<0.05$).

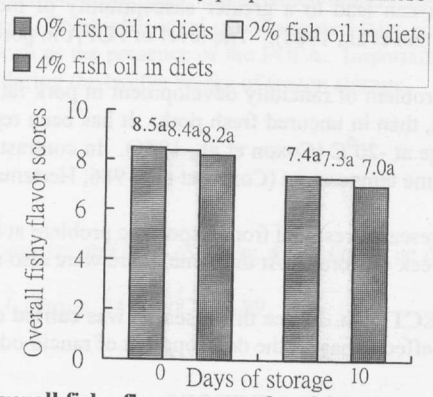

Fig 1. Overall fishy flavor scores for chicken frankfurters from chicken supplemented with fish oil.

Table 2. Fatty acid composition for chicken frankfurters from chicken supplemented with fish oil

Fatty acids[a]	*Fish oil (%) in diets*		
	0	*2*	*4*
C14:0	0.95	1.13	1.29
C16:0	21.13	20.93	20.44
C16:1	2.63	2.99	3.09
C18:0	8.77	9.27	9.85
C18:1	39.19	40.03	39.53
C18:2(N-6)	24.03	21.58	19.43
C18:3(N-3)	1.44	1.25	1.16
C20:1	0.75	0.81	0.86
C20:4(N-6)	0.38	0.37	0.43
C20:5(N-3)	0.22	0.82	1.66
C22:6(N-3)	0.51	0.82	1.26
N-6 Fatty acids	24.41b	21.95c	19.86d
N-3 Fatty acids	2.17d	2.89c	4.08b
N-6/N-3 Fatty acids	11.25b	7.60c	4.87d

[a] g / 100g total fatty acids.
[b-d] Means in the same row with different letters are significantly different ($P<0.05$).

Table 3. EPA and DHA content of fresh chicken and chicken frankfurters from chicken supplemented with fish oil

	Fatty acids[a]	*Fish oil (%) in diets*		
		0	*2*	*4*
Fresh chicken breast meat	EPA	20c	40b	50b
	DHA	20c	50b	50b
Fresh chicken Skin	EPA	130c	1700b	2460b
	DHA	60c	760b	1040b
Chicken frankfurters	EPA	30d	119c	246b
	DHA	22d	118c	186b

[a] mg / 100g meat or skin.
[b-d] Means in the same row with different letters are significantly different ($P<0.05$).