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FATTY ACIDS CHEMICAL QUALITY OF COOKED CHICKEN LUNCHEON MEAT PRODUCT PRODUCED BY THE USE OF FAT REPLACERS

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Abstract:
Nowadays, there is a great interest regarding demand for foods with low-fat meat products to decrease the risk of nutritional diseases. Several strategies had been reported to reduce fat contents of meat products. The term fat replacer is used to describe a wide variety of products that replace some or all of the fat in foods. In the last years, chicken luncheon meat became one of the most commonly widely marketed and distributed meat products all over the world due to its delicious taste and cheap price. In this study, the chemical quality of the chicken luncheon meat produced either by; sun flower oil, sun flower oil and sodium alginate, sun flower oil, sodium alginate and rice flour, sun flower oil, sodium alginate, rice flour and gum Arabic as fat replacers was evaluated according to market reference toward production of new chicken meat luncheon of low fat, cholesterol and calories. The results revealed that application of fat replacers in cooked chicken luncheon meat enhanced the quality of saturated, monounsaturated and polyunsaturated fatty acids improving its nutritional value.

Keywords: Fat; Fatty Acid; Chicken Luncheon Meat; Fat Replacers.

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1. Introduction

Fat content of the meat products controls the texture, flavor and juiciness of the product. Fat reduction produces dry, bland and hard texture, rubbery product (Keeton, 1994). However, increase of dietary fat lead to certain diseases; cardiovascular diseases (Rossum et al., 2000), hypertension and obesity.

Nowadays, healthier food products are demanded by the consumer and the associated diet trends have caused food manufacturers to explore the use of alternatives for fat. Recent researches replaced fat of some meat products by incorporation of a variety of non-meat ingredients to obtain acceptable reduced- fat meat products (Jimenez Colmenero, 2000; Kumar et al., 2007; Ibrahim et al., 2011).

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Numerous ingredients have been used as a fat replacer to decrease the risk of fat in the meat products; water (Ahmed et al., 1990), starches (Manish Kumar et al., 2004), hydrocolloids (Bloukas et al., 1997; Manish Kumar and Sharma, 2004b), collagen preparates, diet fibers (Akoh, 1998; Mendoza et al., 2001). Moreover, chemical composition and functional quality properties have to be considered by Luncheon meat producers to obtain products of high superiority that act in accordance with the consumer's health.

Luncheon meat is one of the most acceptable meat products; which is commonly used worldwide. It is usually consisting of finely chopped meat and fat with or without some added cereals, cured with salt and nitrite and heat processed (Ranken, 1984). Soliman, 1999 reported that beef burger, sausage and luncheon are common foods in the world due to their competitive price, fast processing and delicious taste.

This study aimed to evaluate the chemical composition of the fatty acids of cooked chicken luncheon that produced by different fat replacer in order to produce healthier meat products.

2. Materials and Methods

2.1. Chemical Analysis of Fatty Acids of Market Chicken Luncheon Meat

2.1.1. Samples

A total of eighty typical commercially produced meat product samples, including twenty samples each of emulsion-type chicken luncheon meat, were collected from different supermarkets in Giza and Cairo cities within one week of their production. Each sample was represented by three packages. The collected samples were transported in a cooling ice box to the laboratory within 30 minutes and examined immediately after arrival to investigate their quality attributes.

2.1.2. Fatty Acid Analysis

The hexane solvent containing extracted fat was evaporated under a nitrogen flow, and the extracted lipids were methylated according to the Morrison and Smith (1964) procedure, modified by Sturdivant et al. (1992). The resultant fatty acid methyl esters were separated and analyzed by means of an automated gas liquid chromatograph equipped with a 1.8 m x 3.2 mm stainless steel column packed in GP 10% sp 2330 on 100/200 Chromosorb WAW. The samples were chromatographed at a temperature gradient of 110-210^{0}C. The flow rate of the carrier gas (nitrogen) was 22 mL/min. A known amount of an internal standard (methyl;laurate) was added to each sample. A standard of known composition was analyzed to verify the identity of the fatty acids in the samples. Fatty acid peaks determined by gas chromatography were then used to calculate amounts of fatty acids according to calculations described by Slover and Lanza (1979).

2.1.3. Fatty Acid Profile and Cholesterol Content

Fatty acid peaks and cholesterol content were determined using gas liquid chromatography at the Central Laboratory, Faculty of Agriculture, Cairo University. The lipids were extracted (in duplicate) from the frankfurter samples by the method of (Folch et al. 1957). The extracted lipids

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were then dissolved in 15 ml hexane, and a 5 ml hexane solution was separated for fatty acid analysis and the remainder for cholesterol analysis.

2.2. Preparation of Cooked Chicken Luncheon Meat Product by the Use of Fat Replacers and Chemical Analysis of their Fatty Acids

2.2.1. Preparation of Raw Meat Materials Samples

Chicken meat materials were initially ground through a 4 mm plate, while fat tissues were ground through a 3 mm plate.

2.2.2. Meat Batter Formulations

For production of chicken luncheon meat, four different meat batters (10 kg batches of each meat batter) were produced. The first batter was the control samples which are prepared according to the Egyptian specification standards number 1696/2005 for chicken luncheon and the second batter was prepared with 15% sunflower oil instead of the chicken fat, where meat chicken was chopped in the bowel cutter (Laska) with 2.2% NaCl and 0.30% sodium tripolyphosphate. Sunflower oil was added at approximately -2˚C, and finally wheat starch was added at 2˚C. Next, the meat batter was chopped to a final temperature of 8◦C. Sunflower oil and sodium alginate were used to prepare the second meat batter, the third meat batter was prepared with sunflower oil, sodium alginate plus 1.5% rice flour, and the final trial was prepared with sunflower oil, sodium alginate, 1.5% rice flour and 0.5% gum Arabic. All the prepared meat batters were stuffed into polyamide casings using automatic filler (Handtmanm VF 600) and kept refrigerated for three hours before thermal treatment (I.T. 72˚C).

3. Results and Discussion

Table 1: Fatty acid profile of examined market chicken luncheon samples

Fatty acid	**Chicken luncheon**
C12:0	-
C14:0	2.90
C16:0	26.25
C16:1	2.90
C18:0	18.10
C18:1	40.45
C18:2	5.69
C18:3	1.10
C20:0	0.81
Total saturated	48.06b
Total monounsaturated	43.35b
Total polyunsaturated	6.79b
Cholesterol mg/g	232.77b

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Table 2: Changes in fatty acid profile of chicken luncheon meat produced with different fat replacers during different refrigeration storage

	Time (w)	C12:0	C14:0	C16:0	C16:1	C18:0	C18:1	C18:2	C18:3
T1	0	0.80	3.50	5.00	3.50	5.00	31.50	45.50	1.70
	2	0.76	3.50	4.96	3.45	4.90	31.48	45.45	1.70
	4	0.75	3.45	4.95	3.42	4.86	31.45	45.43	1.68
	6	0.72	3.42	4.90	3.40	4.85	31.40	45.41	1.65
	8	0.70	3.40	4.90	3.37	4.82	31.40	45.40	1.63
	10	0.68	3.37	4.89	3.35	4.80	31.38	45.38	1.60
	12	0.65	3.35	4.85	3.30	4.78	31.35	45.35	1.59
T2	0	0.75	3.50	4.96	3.48	5.00	31.00	45.60	1.75
	2	0.75	3.49	4.95	3.46	4.99	31.00	45.60	1.73
	4	0.73	3.47	4.94	3.35	4.95	30.95	45.56	1.71
	6	0.70	3.46	4.92	3.30	4.93	30.94	45.55	1.70
	8	0.70	3.45	4.90	3.30	4.90	30.93	45.50	1.70
	10	0.68	3.42	4.85	3.29	4.89	30.90	45.45	1.69
	12	0.67	3.40	4.80	3.25	4.87	30.90	45.43	1.67
T3	0	0.70	3.40	4.50	3.40	5.00	31.20	45.65	1.75
	2	0.70	3.38	4.49	3.38	5.00	31.18	45.62	1.73
	4	0.68	3.35	4.48	3.37	4.95	31.16	45.60	1.72
	6	0.68	3.35	4.47	3.35	4.95	31.15	45.60	1.70
	8	0.65	3.32	4.45	3.30	4.92	31.15	45.57	1.70
	10	0.64	3.30	4.42	3.30	4.90	31.12	45.56	1.68
	12	0.62	3.30	4.40	3.25	4.90	31.10	45.56	1.66
T4	0	0.70	3.40	4.40	3.20	5.10	31.40	45.60	1.80
	2	0.69	3.38	4.40	3.19	5.05	31.37	45.60	1.76
	4	0.68	3.38	4.38	3.15	5.02	31.35	45.59	1.75
	6	0.66	3.36	4.36	3.15	5.00	31.34	45.56	1.75
	8	0.65	3.35	4.35	1.14	4.98	31.34	45.55	1.73
	10	0.62	3.35	4.33	3.12	4.98	31.30	45.52	1.72
	12	0.60	3.32	4.30	3.10	4.95	31.30	45.50	1.70

Table 3: Changes in fatty acid profile of chicken luncheon meat produced with different fat replacers during refrigeration storage (at 0 time)

Fatty acids / Treatment	Saturated fatty acids	Monounsaturated fatty acids	Polyunsaturated fatty acids	Cholesterol
T1	14.30^{a}	35.00^{a}	47.20^{a}	129.00^{a}
T2	13.77^{b}	34.15^{a}	47.10^{a}	128.00^{b}
T3	13.22^{b}	34.35^{a}	47.22^{a}	126.00^{b}
T4	13.28^{b}	34.20^{a}	47.20^{a}	125.25^{c}

$^{a-c}$ Values with different superscripts within the same columns differ significantly at($P<0.05$).

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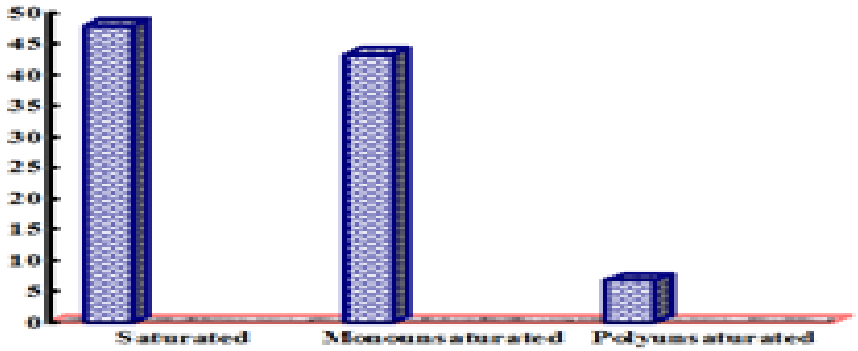

Figure1: Fatty acids profile of market samples

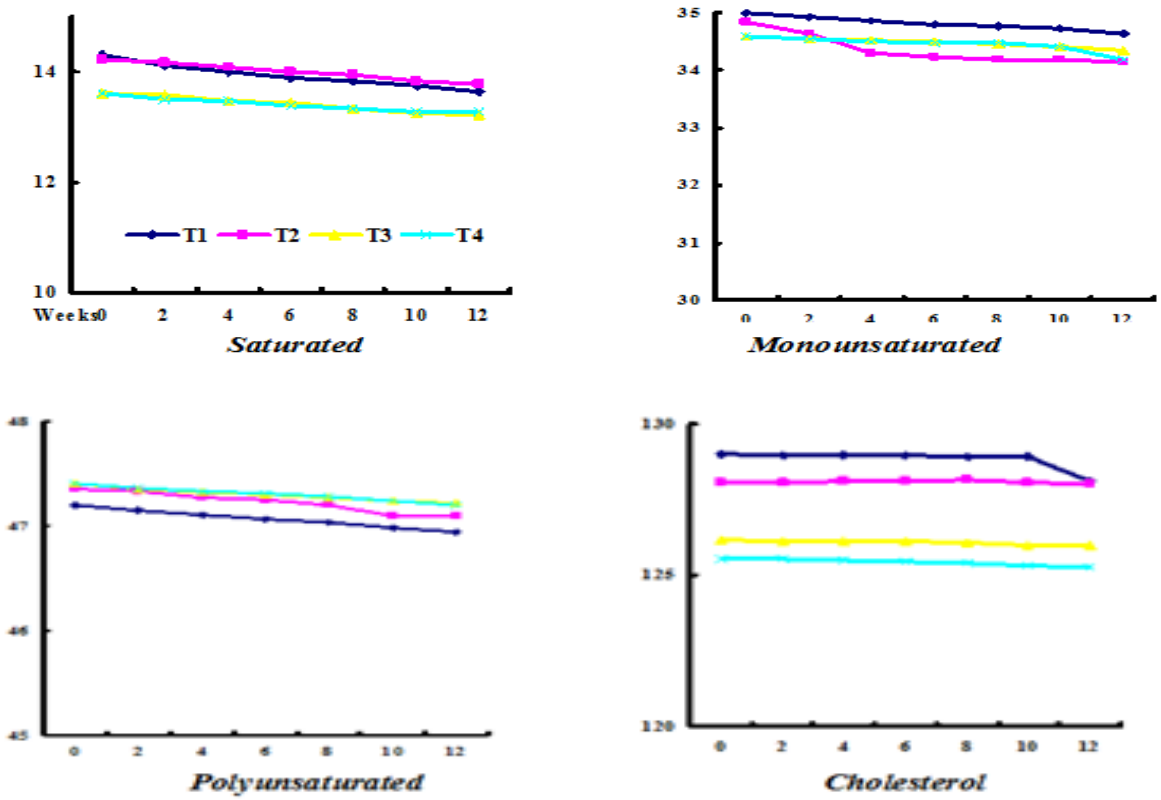

Figure 2: Changes in fatty acid profile and cholesterol content of chicken luncheon meat produced with different fat replacers during weeks of refrigeration storage

In this study, the chemical quality of the experimental meat chicken luncheon products produced by different fat replacers has to be evaluated according to market samples of chicken luncheon. Table 1 showed the results of chemical investigation of essential fatty acids; C12:0, C14:0, C16:0, C16:1, C18:0, C18:1, C18:2, C18:3, C20:0 for the collected market samples and Fig. 1 represented the values of saturated, monosaturated and polysaturated fatty acids of market chicken luncheon meat. These records used as a reference to evaluate the experimental cocked chicken luncheon meat that processed using fat replacers. Table 2 represented the values of essential fatty acids of the experimentally processed chicken luncheon meat treated by sun flower (T1), sun flower oil and sodium alginate (T2), sun flower with sodium alginate and rice flour (T3), sun flower with

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alginate mixed with rice flour with gum Arabic (T4) at different refrigeration periods weekly started at 0 week until 12 weeks. The results revealed that C16 and C18 were the predominant saturated fatty acids in all the examined products, whereas C18:1 was the prevalent monounsaturated fatty acid. This result agree with Tokusoglu and Ünа, 2003.Also, the findings of analysis showed that the percentages of saturated, monounsaturated, respectively, were 48.06, 43.35 and for market chicken luncheon meat (Table 1) decreased to 14.30, 35.00 for T1; 13.77, 34.15 for T2, 13.22, 34.35 for T3 and 13.28, 34.20 T4 (Table 2). Oppositely, polyunsaturated fatty acids elevated from 6.79 to 47.20, 47.10, 47.22 and 47.20 for T1, T2, T3 and T4, approximately Table 2 and Figure 2.

The mean cholesterol contents (mg/g) of the examined samples were 232.77 for market chicken luncheon meat (Table 2). The obviously high saturated fatty acid content and cholesterol content of the examined samples, especially the emulsion type samples, may be due to the use of chicken skin as a basic raw material in the processing of these products (Emara and Nouman, 2002a). This study showed significant decrease of cholesterol content of chicken luncheon produced by fat replacers (Figure 2.D) for about 56% in comparison to market sample at 0 weeks of storage. T4 showed the lowest content of cholesterol 125.25 mg/g. Hence, (Slattery et al., 1999; Grundy, 1994) related between the high content of cholesterol and saturated FAs in meat products and obesity and cancer so, replacement of animal fat content of chicken luncheon by sunflower oil, sodium alginate, rice flour and gum Arabic of chicken luncheon may be advisable in processing healthy chicken luncheon.

Fatty acid analysis of experimentally produced products manufactured with different fat replacers showed that the mean saturated fatty acids was 14.30% for the first treatment decreased significantly for all types of chicken luncheon meat produced by different fat replacers; 13.77, 13.22 and 13.28 of T2, T3 and T4, respectively (Table 3 and Fig. 2). These findings are in agreement of (Paneras and Bloukas, 1994; John et al., 1986).

The current study showed that the analysis of saturated, monounsaturated and polyunsaturated FAs (%) of T1 were 14.30, 35.00, 47.20; 13.77, 34.15, 47.10 for T2; 13.22, 34.35 and 47.22 for T3 and 13.28, 34.20 and 47.20 for T4 (Table 3). These findings showed that saturated, monounsaturated and polyunsaturated FAs decreased significantly in comparison to market samples of chicken luncheon (Table 1 and Table 3).

The cocked chicken samples of different treatments were stored for 12 weeks and the profile of saturated, monounsaturated, polyunsaturated FAs weekly. Storage of chicken luncheon treated by replacement of animal fats by sunflower oil (T1) decreased the saturated FAs and cholesterol gradually from 0 until 12 weeks.

The cholesterol contents (mg/g) of the control chicken luncheon meat samples was 129 decreased significantly for the experimentally processed chicken luncheon meat (T2,T3 and T4 were 128, 126 and 125.25, respectively (Table 3). These alterations in cholesterol levels may be attributable to fat reduction, non-meat ingredient characteristics and process treatments (Jimenez Colmenero, 2000; Marquez et al., 1989).

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4. Conclusion

Our results showed that partial substitution of animal fat with sun flower oil and sodium alginate, sun flower with sodium alginate and rice flour, sun flower with alginate mixed with rice flour with gum Arabic could be used to improve the fatty acid profiles of fatty acids of processed chicken meat luncheon significantly. So, these results can be used to develop manufacturing of less fat, healthier meat products

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