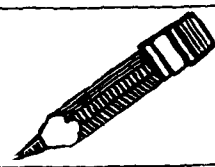


# Technical News Feature



## Comparison of Total Fat, Fatty Acids, Cholesterol, and Other Sterols in Mayonnaise and Imitation Mayonnaise

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### ABSTRACT

Nine brands of mayonnaise and five brands of imitation mayonnaise were purchased from supermarkets in the Washington, DC, area. The samples were analyzed for total fat, fatty acids, sterols, and moisture. Little variation in total fat and saturated fatty acid values was observed among the brands of mayonnaise. The polyunsaturated fatty acid content of mayonnaise ranged from 28.0 to 47.9 g/100 g product. The cholesterol levels were divided between two ranges, 50-55 and 75-79 mg/100 g product. In contrast, there was wide variation in the lipid composition of the different brands of imitation mayonnaise. The total fat values for these products varied from 14.3 to 50.4 g/100 g product. The cholesterol content varied between 0 and 72 mg/100 g product; the latter figure equals the cholesterol content of many of the mayonnaise samples.

### INTRODUCTION

Public interest in cholesterol, saturated vs. polyunsaturated fatty acids, and other nutritional information has increased in recent years. As a result, many new products have entered the market. One such product is imitation mayonnaise. The purpose of this study was not only to compare imitation mayonnaise with mayonnaise but also to compare the various brands of imitation mayonnaise. Total fat, fatty acids, sterols, and moisture were determined.

### EXPERIMENTAL PROCEDURES

#### Samples

Nine brands of mayonnaise and five brands of imitation mayonnaise were purchased from supermarkets in the Washington, DC, area. No initial preparation was necessary for any of the products. Each sample taken for analysis contained ca. 1 g fat.

#### Methods

**Extraction:** A volume of 2:1 chloroform-methanol ca. 20 times the sample weight was added to the weighed sample. The sample-solvent mixture was homogenized ca. 2 min in a blender and then filtered. The crude extract was washed with 0.2 its volume of water, and the chloroform layer was separated. The water layer was washed two more times with the solvent, the solvent layers were combined, and the solvent was removed in a flash evaporator. Details of this procedure have been previously described by Folch et al. (1).

**Moisture:** Moisture was determined as described by the Association of Official Analytical Chemists (AOAC) (2).

**Preparation of esters:** The methyl esters of fatty acids were prepared from the petroleum ether extracts of the fat

residues by the AOAC method (2) as modified by Solomon et al. (3).

The butyrate esters of the sterol compounds were prepared by reacting an aliquot of the fatty acid methyl ester solution with a 2:1 (v/v) butyric anhydride-pyridine solution. Details of this procedure have been described by Sheppard et al. (4,5).

**Gas liquid chromatography:** The parameters and column conditions used for determining the methyl (6) and butyrate (4,5) esters have been published.

**Polyunsaturated fatty acids:** Details of this procedure have been previously described by Sheppard et al. (4).

### RESULTS AND DISCUSSION

The extraction method used was selected as the method of choice from a recent comparison study of various methods for total lipid extraction (7). Improved reproducibility and effectiveness were obtained by using a chloroform-methanol extraction system.

The values for total fat and saturated fatty acids (Table I) varied little among brands of mayonnaise, with an overall mean value of 81.9 and a standard deviation (SD) of  $\pm 2.7$  g/100 g product for the total fat and  $12.2 \pm 0.5$  g/100 g product for the saturated fatty acid methyl esters. The polyunsaturated fatty acids (PUFA) values (Table I) varied more, with a mean value of  $40.6 \pm 7.5$  g/100 product.

When the fatty acid methyl ester (FAME) patterns were examined, mayonnaise 3 and 4 displayed atypical gas liquid chromatographic (GLC) profiles. As seen in Table I, the C18:1 values are elevated and the C18:3 values are lower with constant C16:0 for these two mayonnaise products. Such FAME pattern shifts are suggestive of partial hydrogenation of the soybean oil constituent. Mayonnaise 3 and 4 were the only two products found to contain detectable amounts of material with a C20:0 retention time.

The saturated fatty acid-to-PUFA ratios (Table I) for mayonnaise had a mean ratio of  $1:3.35 \pm 0.7$ . Mayonnaise 3 and 4 exhibited a relatively lower ratio (1:2.17 and 1:2.20, respectively). Comparison of the enzymatic PUFA analysis with the GLC analysis of the PUFAs for mayonnaise 3 and 4 (Table I) indicated the presence of *trans* PUFAs in relatively high quantities. The *trans* fatty acids are produced during the partial hydrogenation of fats and oils. Mayonnaise 5 had the highest ratio of saturated fatty acids to PUFAs. This was the only product for which the label information did not specifically indicate soybean oil as the component oil.

The sterol values (Table II) for mayonnaise were divided between two levels of cholesterol concentration. Four brands of mayonnaise contained an average of 53 mg cholesterol per 100 g product, and the other five brands averaged 77 mg cholesterol per 100 g product. The higher concentration of cholesterol was probably due to the fact

TABLE I  
Fat and Fatty Acid Content (g/100 g Product) of Mayonnaise and Imitation Mayonnaise<sup>a</sup>

Product	Fatty acid methyl esters								Sat. <sup>b</sup>	PUFA <sup>c</sup>	Sat./PUFA ratio	Total fat
	C14:0	C16:0	C16:1	C18:0	C18:1	C18:2	C18:3	C20:0				
Mayonnaise												
1	1.5	7.5	ND <sup>d</sup>	3.3	22.7	35.1	4.1	ND	12.2	39.0	1:3.20	78.5
2	T <sup>e</sup>	8.5	0.2	3.8	20.6	41.6	5.8	ND	12.2	47.2	1:3.87	82.6
3	T	8.8	0.2	4.0	29.7	37.4	1.3	0.3	13.3	28.9	1:2.17	83.3
4	0.1	8.7	0.3	3.6	26.7	35.6	3.1	0.5	12.7	28.0	1:2.20	80.3
5	ND	8.6	0.2	3.1	18.2	43.8	6.2	ND	11.7	47.9	1:4.09	82.9
6	0.1	8.2	T	3.6	20.1	40.8	4.4	ND	11.7	45.0	1:3.85	83.3
7	ND	8.1	T	3.4	19.7	39.7	4.9	ND	11.5	44.4	1:3.86	81.5
8	ND	8.5	0.2	3.8	20.1	40.1	4.8	ND	12.3	40.1	1:3.26	81.4
9	ND	8.4	0.2	3.8	20.4	41.7	5.5	ND	12.2	45.2	1:3.70	83.2
Imitation mayonnaise												
1	T	3.1	T	1.4	7.7	15.2	1.7	ND	4.5	16.0	1:3.56	31.2
2	T	1.8	T	0.8	4.0	7.8	1.1	ND	2.6	8.8	1:3.38	16.5
3	T	4.2	0.2	1.7	9.1	20.3	2.8	ND	5.9	23.1	1:3.92	40.5
4	T	2.0	T	0.8	3.4	6.5	1.3	ND	2.7	7.6	1:2.81	14.3
5	T	6.2	ND	2.3	11.1	23.3	5.1	ND	8.5	28.2	1:3.32	50.4

<sup>a</sup>Each value is the mean of two analyses.

<sup>b</sup>Sat. = saturated fatty acids.

<sup>c</sup>PUFA = polyunsaturated fatty acids determined by enzymatic analysis.

<sup>d</sup>ND = none detected.

<sup>e</sup>T = trace, less than 0.1 g/100 g product.

TABLE II  
Sterol and Moisture Content of Mayonnaise and Imitation Mayonnaise<sup>a</sup>

Product	Cholesterol (mg/100 g)	Campesterol (mg/100 g)	Stigmasterol (mg/100 g)	Sitosterol (mg/100 g)	Moisture (%)
Mayonnaise					
1	50	54	38	138	16.1
2	55	41	42	120	13.7
3	77	48	48	155	12.1
4	79	53	50	126	13.9
5	78	47	47	113	15.2
6	55	44	46	110	14.8
7	53	46	48	114	15.5
8	75	45	51	109	12.8
9	75	61	65	125	11.9
Imitation mayonnaise					
1	36	12	10	34	60.4
2	31	11	10	25	74.8
3	72	23	21	58	45.0
4	25	17	18	27	53.4
5	0	57	63	97	30.8

<sup>a</sup>Each value is the mean of two analyses.

that egg yolks and not whole eggs were incorporated into the product.

The imitation mayonnaise brands had wide variations in total fat, saturated fatty acids, PUFAs (Table I), sterols, and moisture (Table II). The most striking variation among the imitation products was the cholesterol concentration. Imitation mayonnaise 5 contained 0 mg cholesterol per 100 g product, while imitation mayonnaise 3 contained 72 mg cholesterol per 100 g product (Table II). The latter product contained as much cholesterol as many mayonnaises, even though it contained only half as much fat (Table I) as mayonnaise. Cholesterol is absent from imitation mayonnaise 5 because no egg yolk or other animal source products were used in its manufacture.

Although there were wide variations in total fat, saturated fatty acids, and PUFAs, the overall saturated-to-PUFA ratios were fairly similar with respect to each other (Table I).

The main ingredients in both mayonnaise and imitation mayonnaise are the same, with a few exceptions. The imitation mayonnaise contained modified food starch, which decreased the amount of fat and increased the water con-

tent. One imitation mayonnaise contained nonfat yogurt in addition to the other ingredients.

#### REFERENCES

- Folch, J., M. Lees, and G.H. Sloane Stanley, *J. Biol. Chem.* 226:497 (1957).
- Association of Official Analytical Chemists, "Official Methods of Analysis of AOAC," AOAC, Washington, DC, 1975.
- Solomon, H.L., W.D. Hubbard, A.R. Prosser, and A.J. Sheppard, *JAOCs* 51:424 (1974).
- Sheppard, A.J., W.D. Hubbard, and A.R. Prosser, "Interim Methodology Instructions No. 2 for Implementing Requirements of Title 21, Section 1.18," June 11, 1974, Division of Nutrition, Food and Drug Administration, Washington, DC 20204.
- Sheppard, A.J., D.R. Newkirk, W.D. Hubbard, and T. Osgood, *J. Assoc. Off. Anal. Chem.* 60:1302 (1977).
- Sheppard, A.J., W.D. Hubbard, and A.R. Prosser, *JAOCs* 51:416 (1974).
- Hubbard, W.D., A.J. Sheppard, D.R. Newkirk, A.R. Prosser, and T. Osgood, *Ibid.* 54:81 (1977).

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