These results clearly show that the data for any one brand cannot be considered representative of corn snack foods in general.

The results for both potato chips and corn snack food lipids are so variable between brands that the use of mean values in food composition tables to calculate dietary intakes would not accurately reflect food consumption.

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Individual Lipids and Proximate Analysis of Various Foods. 2. Frankfurters and Other Meat and Poultry Products

David R. Newkirk,* Alan J. Sheppard, Willard D. Hubbard, and Theodore Osgood

Samples of all-beef, beef-pork, and chicken frankfurters as well as various other meat and poultry products were purchased from several area supermarkets. The samples were analyzed for water, total fat, fatty acids, protein, ash, and sterols. Cholesterol values ranged from 7 to 100 mg/100 g of product. The fat content of the products varied from 2 to 30 g/100 g of product. All of the products were compared with respect to proximate analysis and sterol and fatty acid content.

Public interest in cholesterol, saturated vs. polyunsaturated fatty acids, and other nutritional information has increased in recent years. The purpose of this study was to compare and report nutritional information obtained from the analysis of various meat and poultry products. The nutrient content of the three varieties of frankfurters (all-beef, beef-pork, and chicken) was of particular interest because chicken frankfurters are a relatively new product and information on their composition, relative to the other two varieties, is not widely available. Measurements were obtained for water, total fat, fatty acids, sterols, protein, and ash.

MATERIALS AND METHODS

A variety of brands of frankfurters, corned beef hash, frozen pot pies, beef stew, lasagna, ravioli, deviled ham, beef chili, sloppy joe mix (beef and pork), and processed pork (spam-type) were obtained from several area supermarkets. The samples were homogenized in a Waring blender. Fat, sterols, and other lipids were extracted by the chloroform–methanol procedure previously described by Folch et al. (1957). The methyl esters of the fatty acids were prepared by the Association of Official Analytical Chemists (AOAC) (1975) method as modified by Solomon et al. (1974). The butyrate derivatives of the sterol compounds were prepared by reacting an aliquot of the fatty acid methyl ester (FAME) solution with butyric anhydride–pyridine solution (2:1, v/v). The details of this procedure have been described by Sheppard et al. (1974, 1977). A sufficient amount of sample was taken for the extraction step so that ca. 1 g of fat was recovered. All gas–liquid chromatographic (GLC) analyses were performed in duplicate. Official methods of the AOAC (1975) were used for the proximate analysis.

Division of Nutrition, Food and Drug Administration, Washington, D.C. 20204.

RESULTS AND DISCUSSION

The data given in Tables I and II are averages of duplicates. Where mean values ± standard deviations are given in the text, the calculations are based on the individual analysis of each sample rather than the average of the duplicates as shown in the tables.

The total FAME for all three varieties of frankfurters have a mean value of 24.0 ± 2.1 g/100 g of product. When the total FAME values of each type of frankfurters were compared, little difference was noted (beef-pork 25.6 ± 1.9, all-beef 23.6 ± 1.6, chicken 22.7 ± 1.7). When the individual FAME values were examined (Table I), the chicken frankfurters differed significantly from either the beef-pork or the all-beef variety. The polyunsaturated fatty acids of the chicken variety were much higher (4.9 ± 1.0 g/100 g of product) than the other varieties (beef-pork 1.3 ± 0.4 and all-beef 0.8 ± 0.1 g/100 g of product). The frankfurters made with chicken contained the smallest amount of total saturated fatty acid. The actual values for these analyses were: beef-pork 11.4 ± 1.4, all-beef 10.5 ± 0.8, and chicken 6.8 ± 0.5 g/100 g of product.

Table I. Fatty Acid Content (g/100 g of product) of Frankfurters and Other Meat and Poultry Products[a]

Sample	Fatty acid methyl esters											
	C12:0	C14:0	C14:1	C16:0	C16:1	C18:0	C18:1	C18:2	C18:3	Sat.	Polyunsat.	Total
Frankfurters												
Beef-pork 1	ND[b]	0.9	0.4	6.8	1.5	4.0	11.0	0.7	0.4	11.6	1.1	25.5
Beef-pork 2	ND	0.6	0.3	5.8	1.2	3.7	11.0	1.4	0.4	10.0	1.8	24.3
Beef-pork 3	ND	0.9	ND	7.4	1.4	4.2	12.0	1.2	ND	12.5	1.2	27.1
All beef 1	ND	0.8	0.4	6.5	1.5	3.8	11.2	0.6	0.3	11.1	0.9	25.2
All beef 2	0.1	0.8	0.5	6.0	1.6	4.0	10.0	0.5	0.2	10.8	0.7	23.4
All beef 3	ND	0.8	0.2	5.9	1.0	3.0	10.5	0.6	0.3	9.6	0.8	22.3
Chicken 1	ND	0.3	0.1	5.6	1.7	1.5	9.3	5.7	0.4	7.4	6.1	24.7
Chicken 2	0.2	0.2	0.2	4.9	1.3	1.3	8.4	4.4	0.2	6.6	4.6	21.1
Chicken 3	ND	0.2	Tr[c]	5.0	1.5	1.3	9.1	4.0	ND	6.5	4.0	22.2
Meat and poultry products												
Beef hash 1	ND	0.5	0.2	2.7	0.5	1.8	4.0	1.1	0.7	5.0	1.8	11.6
Beef hash 2	Tr	0.4	0.1	2.7	0.7	1.8	4.5	0.2	0.1	4.9	0.3	10.5
Beef stew 1	ND	0.2	ND	1.0	ND	0.8	1.3	0.5	0.2	2.0	0.7	4.0
Beef stew 2	Tr	0.2	Tr	0.8	0.2	0.6	1.5	0.5	0.2	1.6	0.7	4.0
Beef stew 3	ND	0.1	ND	1.0	0.1	0.8	1.5	0.1	Tr	1.9	0.1	3.6
Lasagna	Tr	0.3	0.1	1.0	0.3	0.6	1.9	0.1	Tr	1.9	0.1	4.3
Ravioli 1	Tr	0.1	Tr	0.9	0.3	0.6	1.5	0.1	Tr	1.6	0.1	3.5
Ravioli 2	Tr	0.1	Tr	0.4	0.1	0.3	0.8	0.1	Tr	0.8	0.1	1.9
Beef chili	ND	0.3	0.2	2.7	0.6	1.4	4.5	0.4	0.5	4.4	0.9	10.6
Beef-sloppy joe	ND	0.4	0.2	2.9	0.6	1.7	4.6	0.3	0.1	5.0	0.4	10.8
Pork-sloppy joe	ND	0.1	ND	1.7	0.2	0.8	3.4	0.9	ND	2.6	0.9	7.1
Deviled ham	ND	0.3	ND	4.8	0.7	2.8	8.6	2.9	0.5	7.9	3.4	20.6
Beef pot pie	ND	0.2	ND	1.8	0.2	1.2	2.4	1.3	ND	3.2	1.3	7.1
Chicken pot pie	ND	0.1	ND	1.8	0.3	1.2	3.1	1.3	0.1	3.1	1.4	7.9
Turkey pot pie	ND	0.1	ND	1.7	0.2	1.1	2.4	1.3	0.5	2.9	1.8	7.3
Processed pork (spam-type)	ND	0.4	ND	7.1	1.0	3.3	14.3	3.2	0.1	10.8	3.3	29.4

[a] Values are the averages of duplicate analyses. [b] ND = none detected. [c] Tr = less than 0.1 g/100 g of product.

Table II. Proximate Analysis and Cholesterol Content of Frankfurters and Other Meat and Poultry Products[a]

Sample	Proximate analysis, g/100 g of product				Sterol, mg/100 g of product			
	Water	Protein	Ash	Total fat	Cholesterol	Campesterol	Stigmasterol	Sitosterol
Frankfurters								
Beef-pork 1	54.2	12.6	2.5	26.6	41	ND[b]	ND	ND
Beef-pork 2	51.0	14.5	2.6	25.1	44	ND	ND	ND
Beef pork 3	51.0	14.5	2.6	28.4	55	ND	ND	ND
All-beef 1	48.7	13.9	2.4	26.4	41	ND	ND	ND
All-beef 2	52.4	13.7	2.4	23.9	35	ND	ND	ND
All-beef 3	51.0	13.9	2.4	26.3	44	ND	ND	ND
Chicken 1	54.2	13.9	2.5	24.9	100	ND	ND	ND
Chicken 2	54.0	13.1	3.4	22.3	86	ND	ND	ND
Chicken 3	54.1	13.1	3.0	22.9	96	ND	ND	ND
Meat and poultry products								
Beef hash 1	68.2	8.4	1.8	12.3	30	ND	ND	ND
Beef hash 2	66.6	8.6	1.7	10.9	19	ND	ND	ND
Beef stew 1	82.7	6.0	1.4	4.4	8	ND	ND	ND
Beef stew 2	81.3	6.1	1.6	4.5	10	ND	ND	ND
Beef stew 3	81.3	6.1	1.6	4.2	14	ND	ND	ND
Lasagna	76.4	2.5	2.0	4.4	12	Tr[c]	Tr	Tr
Ravioli 1	72.5	4.0	1.6	3.5	9	Tr	Tr	Tr
Ravioli 2	74.8	4.2	1.6	2.0	9	Tr	Tr	Tr
Beef chili	66.8	6.8	1.3	11.1	20	ND	Tr	10
Beef-sloppy joe	71.1	10.3	1.0	11.8	31	ND	ND	ND
Pork-sloppy joe	75.0	10.6	1.2	7.6	30	ND	ND	ND
Deviled ham	50.5	13.9	3.3	27.0	56	ND	ND	ND
Beef pot pie	61.0	5.1	1.1	11.8	7	4	ND	5
Chicken pot pie	58.8	6.6	1.8	10.8	17	3	ND	7
Turkey pot pie	63.6	5.9	1.2	11.1	14	ND	ND	9
Processed pork (spam-type)	50.6	13.0	3.5	30.2	41	ND	ND	ND

[a] Values are the averages of duplicate analyses. [b] ND = none detected. [c] Tr = less than 1 mg/100 g product.

The results of the determination of proximate analysis and cholesterol for the three frankfurter varieties are shown in Table II. The cholesterol content was another distinguishing factor between the chicken frankfurters and the other two types of frankfurters. The chicken frankfurters averaged 94 mg/100 g of product, 118.6% more cholesterol than the average cholesterol level in the other varieties.

In addition to the three varieties of frankfurters, many other meat and poultry products were analyzed. The fatty acid content of these foods is given in Table I, and the values for proximate analysis and sterols are listed in Table II.

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On the Anaerobic Degradation of Ascorbic Acid in Dehydrated Tomato Juice

Joseph Riemer and Marcus Karel*

During a study aimed at developing methods for computer-aided simulation of ascorbic acid loss in dehydrated tomato juice, we investigated the influence of environmental variables. Previous studies on dehydrated products showed an aerobic reaction in some cases, but no oxygen effect in others. To establish definitively the existence of anaerobic reaction in our system, reaction rates in a catalytically deoxygenated system were compared with rates in the presence of oxygen; and an oxygen mass balance experiment was conducted in a system containing a known and limited amount of oxygen. The results definitively establish that ascorbic acid degradation in dehydrated tomato juice is largely anaerobic.

During storage of dehydrated foods in permeable packages, many changes occur that lead to quality deterioration. An important index in deterioration of dehydrated juices is the loss of vitamin C. Environmental factors and package properties affect the rate of loss of this vitamin, and environmental conditions may change during storage. Moisture is transferred into the package, resulting in the increase of moisture content and equilibrium relative humidity; oxygen is transferred into the package where it may accumulate in the headspace or react with the food. We have recently conducted a study directed at developing methods for computer-aided simulation of ascorbic acid degradation during storage. Dehydrated tomato juice powder was the food chosen for the study, and oxygen pressure was one of the storage variables to be studied. In the course of the study it became apparent that the effect of this variable was negligible. The present paper reports the results of experiments undertaken to establish whether degradation of the vitamin was truly anaerobic in this system.

Vitamin C losses in several dehydrated foods had been reported to be the result of aerobic reaction and, in other foods, an anaerobic degradation reaction. Heberlein and Clifcorn (1944) found that an inert atmosphere favored the retention of ascorbic acid in dehydrated fruits and vegetables at room temperature. Miers et al. (1958) monitored ascorbic acid retention of spray-dried tomatoes during storage and found that high moisture levels, presence of oxygen, and storage temperature above 90 °F were factors detrimental to the storage stability.

On the other hand, the retention of ascorbic acid in storage of tomato flakes was found to be independent of the package atmosphere (Continental Can Co., 1944, 1945), and Karel and Nickerson (1964) found that in stored dehydrated orange juice ascorbic acid degradation occurred at the same rate in air and in vacuum. Lempka and Prominski (1967) and Lempka et al. (1969, 1970) studied the changes in the ascorbic acid content of dehydrated fruits and vegetables and have shown that storage of freeze-dried products in air had little effect on ascorbic acid. In a study of various tomato products during storage, Hummel et al. (1950) found that the amount of oxygen present in the headspace (not considering potential occluded air) could not account for the resulting ascorbic acid degradation and that the reduction of dissolved air by increasing processing time did not improve ascorbic acid retention.

In our studies the effects of various oxygen levels (21, 7.2, 3.5, and 0.2%) on the rate of ascorbic acid degradation in dehydrated tomato juice were found to be insignificant. These observations necessitated further investigation of the following hypotheses: (a) degradation of ascorbic acid in this system is an anaerobic reaction or oxygen is available in the product in quantities sufficient for aerobic degradation; (b) reaction is aerobic, i.e., oxygen is available in the system in quantities sufficient for aerobic degradation; (c) degradation occurs both aerobically and anaerobically. These alternatives are schematically illustrated in Figure 1. In this study we describe the approaches used in determining which of the alternatives is the correct one.

EXPERIMENTAL SECTION

The Food System. Commercially available frozen tomato concentrate (Vitality Brand, Lykes Pasco Co., Dade City, Fla.) was used for preparing a stock of freeze-dried tomato juice powder. The concentrate was diluted 3:1 with distilled water, a point at which it had a 6.7° Brix and a pH value of 4.1. It was frozen (slow freezing, −25 °F) and freeze-dried (Vacudyne freeze-drier) for 72 h. The dehydrated tomato juice was kept in desiccators under vacuum at −25 °F in the dark.

Ascorbic Acid Assay. L-Ascorbic acid was determined by a 2,6-dichlorophenolindophenol titration, an AOAC (1975) official method. Since the investigated samples were

Department of Nutrition and Food Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139.

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