Individual Lipid and Proximate Analysis of Various Foods. 3. Potato Chips and Corn Snack Foods

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Twenty different brands of potato chips, corn puffs, and corn chips were purchased from food stores in the Washington, D.C., and Davis, California areas. These samples were analyzed in duplicate for water, total fat, protein, ash, fatty acids, sterols, and *cis,cis*-methylene interrupted polyunsaturated triglycerides. The data show that considerable variation between brands exists in the fatty acid and sterol patterns in both the potato chip and corn snack food groups. The data indicate that some brands were processed using vegetable oils, whereas others were processed using animal fats. The portion of total polyunsaturated fatty acids that is *cis,cis*-methylene interrupted ranged from about 50% to nearly 100%, depending upon the brand being tested. The lipid content of both potato chips and corn snack foods is so variable between brands that the use of mean values in food composition tables to calculate dietary intake would not accurately reflect actual intake.

More information on the composition of potato chips and similar type foods such as corn puffs and corn chips is needed. Compositional data for these products are virtually nonexistent in the scientific literature. One general entry for potato chips can be found in the U.S. Department of Agriculture (USDA) Handbook No. 8 (Watt and Merrill, 1963) and there are no entries for corn puffs or corn chips. Other widely used food composition tables such as the Heinz Nutritional Data (1972) do not include such foods. Considering the wide use of such products, the composition of potato chips, corn chips, and corn puffs is of considerable interest to nutritionists and dietitians who are calculating the nutrient intake of teenagers, who tend to consume large quantities of these snack foods, and of patients who are instructed by their physicians to modify their fat intake.

This paper is the third in a series (Hubbard et al., 1977; Newkirk et al., 1978) dealing with the water, protein, ash, total fat, fatty acid, sterol, and *cis,cis*-methylene interrupted polyunsaturated triglyceride content of various foods. In this segment of the study, samples of potato chips, corn chips, and corn puffs were obtained from local supermarkets in the Washington, D.C., and Davis, California areas and were analyzed for these compounds.

MATERIALS AND METHODS

Brand name products obtained in the Washington area were: Jane Parker Potato Chips, Party Pride Potato Chips, Pringles Newfangled Potato Chips, Mann's Potato Chips, Muncho's Potato Chips, Utz Potato Chips, A&P Corn Chips, A&P Corn Puffs, Cheetos Cheese Puffs (baked), Cheetos Cheese Puffs (fried), El Paso Taco Shells, Frito's Corn Chips, Safeway Cheese Puffs, and Safeway Corn Chips. Brand name products obtained in Davis, California, were: Albertson's Potato Chips, Granny Goose Potato Chips, Harvest Day Potato Chips, Laura Scudder's Potato Chips, Lay's Potato Chips, and Party Pride Potato Chips. (The tabular data for these products do not reflect this order of listing.)

Samples were ground in a Waring blender and stored at −2 °C before extraction. The extraction procedure has been described by Sheppard et al. (1974). The methyl esters of the fatty acids were prepared for gas–liquid chromatographic (GLC) analysis by the Association of Official Analytical Chemists' (AOAC, 1975) boron trifluoride procedure as modified by Solomon et al. (1974). The method for the preparation of the butyrate derivatives for GLC sterol analysis has been described by Sheppard et al. (1974). Official methods of the AOAC (1975) were used for the determination of water, protein, and ash. Methods described by Sheppard et al. (1974) were used for the remainder of the analyses, including the determination of the *cis,cis*-methylene interrupted polyunsaturated fatty acids by the lipoxidase method.

A sufficient amount of sample was taken for the extraction step so that approximately 1 g of fat was recovered. All samples were analyzed in duplicate.

RESULTS AND DISCUSSION

Potato Chips. A wide range in PUFA content was observed in potato chips analyzed by both the GLC method and the enzymatic method which measures *cis,cis*-trilinolein (Table I). The GLC–PUFA values fall into two broad groups (2.5–7.2% and 14.1–22.3%). The *cis,cis*-trilinolein values also tend toward two groups (1.4–4.7% and 13.2–21.8%). In every case in which the linoleic acid is high with respect to the oleic acid, the *cis,cis*-trilinolein value is similar to the GLC–PUFA value. When a reverse relationship of high oleic acid to linoleic acid occurs, the ratio of *cis,cis*-trilinolein to GLC–PUFA values is less than 1.0. This probably is a reflection of the degree of hydrogenation and indicates the presence of nonconjugated trans fatty acids, which are not separated from the *cis,cis*-trilinolein in the GLC analysis and are not reactive in the enzymatic method. This conclusion has been discussed by Waltking and Zmachinski (1970).

The sterol patterns observed for all the potato chips (Table II), with the exception of brand G, indicated that the lipids were of vegetable origin. The variation in sitosterol probably reflects differences in the deodorization step during oil processing. The oil used for frying brand G obviously contained some animal fat since a substantial amount of cholesterol was found.

The sources of the potatoes used in the eastern United States and those used in the western part of the country are different. The protein content of the eastern brands (G–L) was consistently lower than the western brands (A–F). The protein values of the western products are reasonably consistent with the USDA Handbook No. 8 (Watt and Merrill, 1963) value of 5.3%.

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Table I. Fatty Acid and *cis,cis*-Methylene Interrupted Polyunsaturated Triglyceride Content (g/100 g of Product) of Potato Chips and Corn Snack Foods[a]

Brand	Fatty acid methyl esters									GLC-PUFA[b]	*cis,cis*-Trilinolein
	C12:0	C14:0	C14:1	C16:0	C16:1	C18:0	C18:1	C18:2	C18:3		
					Potato Chips						
A	ND[c]	0.5		13.0	0.1	1.5	11.5	4.6	ND	4.6	2.9
B	ND	0.3		9.9	0.1	0.7	7.4	18.0	ND	18.0	16.0
C	ND	0.4		10.0	0.4	0.9	6.8	14.1	ND	14.1	13.2
D	ND	0.4		13.2	0.1	1.5	11.4	4.8	ND	4.8	3.1
E	0.1	0.4		14.0	ND	1.4	11.7	5.0	ND	5.0	3.1
F	0.1	0.4		14.5	Tr[d]	1.5	12.2	4.5	ND	4.5	3.1
G	ND	0.2		6.7	0.3	0.9	8.1	17.1	0.8	17.9	17.4
H	ND	0.2		7.1	0.1	1.6	18.9	2.4	0.1	2.5	1.4
I	ND	0.3		9.7	0.2	1.1	7.6	21.9	0.4	22.3	21.8
J	ND	0.3		8.6	0.3	1.2	7.4	19.0	0.4	19.4	18.1
K	ND	0.2		6.7	0.3	1.2	13.8	7.2	ND	7.2	4.7
L	ND	0.3		8.8	0.1	0.8	7.2	18.5	0.3	18.8	17.3
					Corn Snack Foods						
M	ND	ND	ND	4.4	ND	1.1	8.9	14.1	0.9	15.0	14.9
N	ND	ND	ND	6.4	ND	1.1	10.7	13.9	1.3	15.2	15.1
O	ND	1.0	0.4	7.9	1.5	5.4	12.4	1.6	0.1	1.7	0.9
P	0.7	0.6	ND	8.5	ND	3.9	28.3	13.5	0.8	14.3	8.5
Q	0.3	0.4	ND	6.3	0.3	1.2	14.1	6.8	0.2	7.0	5.2
R	0.3	0.4	0.2	4.4	0.2	2.8	10.1	8.7	1.7	10.4	8.5
S	0.3	0.6	ND	6.6	1.0	3.9	11.7	4.0	0.9	4.9	4.2
T	ND	Tr	ND	1.6	Tr	0.8	8.5	3.3	0.1	3.4	1.8

[a] Mean value of duplicate assays. [b] Total of C18:2 and C18:3. [c] ND = none detected. [d] Trace = <0.1 g/100 g of product.

Table II. Proximate Analysis and Sterol Content of Potato Chips and Corn Snack Foods[a]

Brand	Proximate analysis (g/100 g of product)				Sterols (mg/100 g of product)			
	Water	Protein	Ash	Total fat	Cholesterol	Campesterol	Stigmasterol	Sitosterol
				Potato Chips				
A	2.1	5.0	3.7	32.2	ND[b]	ND	ND	21
B	2.0	4.7	3.9	37.3	ND	ND	ND	88
C	1.9	4.0	4.6	33.6	ND	ND	ND	89
D	2.1	5.3	4.0	32.2	ND	ND	ND	26
E	2.1	5.1	3.7	33.8	ND	ND	ND	28
F	2.0	5.0	4.1	34.1	ND	ND	ND	27
G	2.1	1.1	5.1	35.2	16	24	17	115
H	2.0	1.6	3.4	33.1	ND	ND	ND	104
I	1.5	1.4	4.1	42.8	ND	ND	ND	Tr[c]
J	2.1	1.0	3.8	39.1	ND	ND	ND	72
K	2.1	1.3	3.5	30.1	ND	ND	ND	455
L	2.2	1.9	4.6	35.6	ND	Tr	ND	121
				Corn Snack Foods				
M	1.2	1.3	2.1	29.7	ND	54	46	159
N	0.9	1.7	1.1	34.3	ND	ND	ND	ND
O	1.1	1.7	2.5	30.8	29	ND	ND	ND
P	2.1	1.0	1.5	62.6	ND	ND	80	97
Q	3.1	1.6	3.3	33.3	ND	ND	ND	82
R	2.3	1.7	2.8	29.8	ND	21	ND	62
S	3.2	1.6	3.3	29.2	52	ND	ND	ND
T	3.7	8.7	2.6	16.1	ND	15	12	39

[a] Mean value of duplicate assays. [b] ND = none detected. [c] Trace = <5 mg/100 g of product.

There was little difference in the moisture or ash content of the potato chips tested regardless of the brand. However, the total fat varied from 30.1% (brand K) to 42.8% (brand I).

These results clearly indicate that the data for any one brand cannot be considered representative of potato chips in general.

Corn Snack Foods. Considerable variation in the fatty acid patterns found between products is evident (Table I). The GLC-PUFA values fall into two broad ranges (1.7–7.0% and 10.4–15.2%) while the *cis,cis*-trilinolein values group as 0.9–5.2% and 8.5–15.1%. Generally the cis,cis value is similar to the GLC-PUFA value when the amount of linoleic acid is high compared to oleic acid. The lower concentration of linoleic acid and *cis,cis*-trilinolein was probably again due to the presence of nonconjugated trans fatty acids which are not reactive in the enzymatic method.

The proximate analysis revealed that the brands varied considerably in composition (Table II). Fat content ranged between 16.1 and 62.6 g/100 g of product and protein ranged between 1.0 and 8.7 g/100 g of product. The moisture and ash content ranges were 0.9–3.7 and 1.1–3.3 g/100 of product, respectively.

The sterol content as well as the fatty acid patterns indicate that the frying fats included vegetable and animal fats; significant amounts of cholesterol are present in the latter fats.

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

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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.

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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.