Effect of Fatty Acid Composition of Oils on Flavor and Stability of Fried Foods

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ABSTRACT: Effects of fatty acid composition of frying oils on intensities of fried-food flavor and off-flavors in potato chips and french-fried potatoes were determined. Commercially processed cottonseed oil (CSO) and high-oleic sunflower oil (HOSUN) were blended to produce oils with 12 to 55% linoleic acid and 16 to 78% oleic acid. Analytical sensory panels evaluated french-fried potatoes and pilot plant-processed potato chips. Initially, both foods prepared in CSO (16% oleic/55% linoleic acid) had the highest intensities of fried-food flavor; however, this positive flavor decreased with decreasing levels of linoleic acid. 2,4-Decadienal in potato chips also decreased with decreasing linoleic acid in the oils. Frying oil stability, measured by total polar compounds (TPC), and oxidative stability of potato chips, measured by volatile compounds, showed that HOSUN (78% oleic acid) produced the lowest levels of TPC and the lowest levels of hexanal and pentanal, indicating greater frying oil stability and oxidative stability of the food. However, fresh potato chips fried in HOSUN had the lowest intensities of fried-food flavor and lowest overall flavor quality. Fried-food flavor intensity was the best indicator of overall flavor quality in fresh potato chips. Volatile compounds, TPC, and oxidative stability index directly varied with increasing oleic acid, and were therefore not directly indicative of flavor quality. No oil analysis predicted flavor stability of aged potato chips. Compositions of 16 to 42% oleic acid and 37 to 55% linoleic acid produced fresh fried-food with moderate fried food flavor intensity, good overall flavor quality, and low to moderate TPC levels (chips only). However, in aged food or food fried in deteriorated oil, compositions of 42 to 63% oleic and 23 to 37% linoleic provided the best flavor stability.
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KEY WORDS: Cottonseed oil, flavor, french-fried potatoes, frying, high oleic sunflower oil, polar compounds, potato chips, sensory, stability, volatile compounds.

Technology is now available to alter the fatty acid composition of oilseeds by genetic modification or traditional breeding (1). Lowering the linolenic acid content in canola and soybean oils has been an objective of plant breeders to improve the flavor quality and oxidative stability of these oils (2–4). Safflower and sunflower oils have also been modified to improve their oxidative stability by increasing oleic acid levels to 70–90% (5–8). Because the composition of a frying fat or oil has a significant effect on the flavor on fried food (9), the effects that these alterations of fatty acid composition have on flavor must be determined. Decreasing linolenic acid and increasing oleic acid in canola oil have been found to give greater frying stability as measured by total polar compounds (TPC); however, potato chips fried in canola oil with 78% oleic acid and 19% linoleic acid had less fried potato flavor than potato chips fried in canola oil with 64% oleic acid and 24% linoleic acid (10). Cottonseed oil (CSO), which has approximately 50–55% linoleic acid, has been an industry standard for frying oil in the United States for producing food with desirable fried-food flavor. Fried-food flavor may be partly derived from the formation of 2,4-decadienal during the thermal oxidation of linoleic acid (11,12). Potato chips fried in oils with a range of linoleic acid from 17 to 78% showed a correlation coefficient of 0.87 ($P < 0.05$) between increasing linoleic acid and decreasing oxidative stability (13). Both the fried-food flavor intensity of the fried food and the length of the frying life of the oil must be optimized by selecting appropriate fatty acid compositions for frying oils. The primary objective of this research was to investigate the effects of varying oleic and linoleic acid composition of oils on flavor characteristics of fresh potato chips and french-fried potatoes and on the storage stability of potato chips. A second objective was to determine the optimal fatty acid composition to achieve a balance between desirable fried-food intensity, storage stability of fried food, and extended fry life of the oil.

MATERIALS AND METHODS

Oils. Refined, bleached, and deodorized (RBD) CSO and RBD high-oleic sunflower oil (HOSUN) were obtained from commercial oil processors. All oils contained citric acid as the only additive. CSO and HOSUN were blended (67:33 and 33:67 ratios) to obtain oils with ranges of linoleic and oleic acid contents. Fatty acid compositions of the initial oils were determined by capillary gas chromatographic (GC) analysis with a Varian 3400 GC (Palo Alto, CA), equipped with an SP2380 column (30 m, 0.25 mm i.d., 0.20 micron film thickness) (Supelco, Bellefonte, PA). Column temperature was

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held at 170°C for 10 min and programmed to 220°C at 3°C/min. Other GC conditions were: injector, 240°C; detector, 280°C. Fresh oils (5 g) were analyzed with the oxidative stability instrument (OSI)(Omnion, Inc., Rockland, MA) at 110°C with a flow rate of 138 mL/min.

Potato chip preparation. Monona variety potatoes, stored 6 mon at 9°C, 93–95% relative humidity, were used after a one-week final storage hold at 13°C. Specific gravity of the potatoes was determined as previously described (14). Prior to frying, tubers were cut into 0.15-cm thick slices by a rotary slicer (Knott Machine Co., Shaw, MA), then washed and de-watered. Potatoes were chipped continuously at a rate of 27 kg of whole raw tubers per hour. Potato chips were fried over a 2-d period as previously described (10). On day 1, 106 L of oil was pumped into the continuous chip fryer (Heat & Control Inc., San Francisco, CA) and heated to frying temperature (192°C) in approximately 30 min. Potato chips were fried for 130 s at temperatures ranging from 192°C (inlet) to 187°C (outlet). At the end of frying on day 1, the oil was cooled and pumped into a holding tank overnight. On day 2, the oil was pumped back into the fryer, and the heating/frying cycle was continued. Make-up oil was added periodically to maintain the 106-L oil level. Complete turnover of oil was achieved between 12 and 15 h on day 2 by periodically removing used oil and adding fresh oil.

Oil and potato chip sampling procedures. Oil (100 g) and potato chip (2 kg) samples were collected from the fryer after 0, 3, 6, 12, 15, and 18 h of frying for later analyses.

Potato chip packaging and storage. Portions (300 g) of potato chips from each sampling period were placed in metallized foil bags and sealed. Potato chips for initial sensory and volatile compound analyses were sampled from sealed bags held at 0°C. Sealed bags of potato chips were aged at 25°C for up to 6 mon.

French-fried potato preparation. Protocol for french-fried potatoes included intermittent frying at 190°C with total heating/frying time of 30 h. Each oil (5000 g) was heated in a 14-L fryer (Model 250EL, Cecilware, West Palm Beach, FL) for 8 h each day for 4 d. Fresh Idaho russet potatoes, purchased locally, were cut into 8-cm lengths of shoestring size (0.5 cm × 0.5 cm) and fried in 150-g batches. Each day, 300 g of fresh oil was added as make-up oil to each sample. The potatoes used for sensory testing were parfried in 150-g batches for 2 min after 1 h of oil use, then finish-fried for 2 min prior to panel sessions after 10, 20, and 30 h of oil usage.

Instrumental and chemical analyses of oils and potato chips. TPC were determined in duplicate by the AOAC column chromatography method (15). Free fatty acid (FFA) contents were measured in duplicate by the AOCS method (Ca 5a-40) (16). Potato chip moisture content was monitored with an infrared moisture meter (Ohaus Moisture Balance 601C, Florham Park, NJ) with the lamp set at 140 W, 2.5 cm above a 10-g sample of crushed chips. Finished chip color was evaluated on an Agtron spectrophotometer (Model M-300; Magnuson Engineering Inc., San Jose, CA) with red mode setting and calibrated with 00 and 90 disks (17).

Volatile compound analysis. Volatile compounds in the fresh and aged potato chips were analyzed with a Perkin-Elmer 8320 capillary GC (Oak Brook, IL), equipped with a flame-ionization detector and fitted with a headspace analyzer (Model HS-6; Perkin-Elmer Co.). Each 1-g portion of ground chips was placed in a 6-mL glass headspace vial, sealed with a Teflon-lined septum and aluminum cap, then placed in the headspace analyzer, and heated to 130°C for 10 min. Samples were run in triplicate. Volatile compounds were collected at the head of the column (DB-5 fused-silica capillary, 30 m × 0.32 mm, 1 micron film thickness; J&W Scientific, Rancho Cordova, CA), held at 0°C and were automatically injected after an initial hold of 5 min. Column temperature was programmed from 0 to 240°C at 20°C/min with a final hold of 5 min. Other GC conditions were: injector temperature, 200°C; detector temperature, 250°C; carrier gas, helium at flow rate of 1 mL/min at 10 psi. Volatile compounds were identified by matching retention times with those of authentic compounds.

Sensory evaluation. A 16-member analytical sensory panel, trained and experienced in evaluating fried foods, rated the potato chips and the french-fried potatoes for intensities of individual flavors, including fried potato, stale, waxy, fruity, woody and fishy, on a 10-point intensity scale with 0 = no intensity and 10 = strong flavor intensity (18). They also rated the overall flavor quality of the potato chips on a 10-point quality scale with 1 = bad quality and 10 = excellent quality. Samples were tested in duplicate and in randomized order for each frying time within each storage time. All evaluations were conducted in a panel room with individual booths, temperature control, and red-colored lighting.

Statistical analysis. Data were analyzed by analysis of variance to determine statistical significance between means (19). Statistical significance was expressed at the $P < 0.05$ level unless otherwise indicated.

RESULTS AND DISCUSSION

Fatty acid composition of oils. Cottonseed and HOSUN oils were selected to generate frying oils with high to low ranges of oleic acid and linoleic acid. Linoleic acid content of the oils ranged from 55% for CSO to 12% for HOSUN, and oleic acid increased from a low of 16% for CSO to a high of 78% for HOSUN (Table 1). The 67:33 and 33:67 blends of CSO/HOSUN provided intermediate levels of oleic and linoleic acids. Stearic acid levels were low (2.2–4.1%) for all oils and blends. Palmitic acid decreased from 24% in the CSO to 4% for HOSUN.

Oil stability. OSI values of the fresh oils were 7.1 ± 0.1 h for CSO, 9.5 ± 0.2 h for 67:33 (CSO/HOSUN), 11.8 ± 0.2 h for 33:67 (CSO/HOSUN), and 14.3 ± 0.3 h for HOSUN. OSI levels directly varied with increasing oleic acid content. Polymerization and hydrolysis of the frying oils used for potato chips and for french-fried potatoes were measured by TPC and FFA. At all heating times except 0 h, there were significant differences in TPC between oils and blends for both types of foods (Tables 2,3). In oils used for potato chips, TPC

TABLE 1
Fatty Acid Compositions of Oils

Oils	Fatty acid content (%) 16:0	18:0	18:1	18:2	18:3
Cottonseed oil (CSO)	24.3	2.2	16.4	54.9	0.1
67:33 CSO/HOSUN	16.2	3.0	42.9	35.7	0.1
33:67 CSO/HOSUN	7.9	3.8	67.5	18.7	0.1
High-oleic sunflower (HOSUN)	3.9	4.1	78.0	12.1	0.1

levels increased with increasing linoleic acid content and decreasing oleic acid levels (Table 2). After 18 h of frying, TPC in the oils used for potato chips ranged from 7.9 to 10.7. These values are similar to those for canola oils with oleic acid levels of 62 to 78% (10). CSO had the highest TPC levels at all oil sampling times. FFA levels increased only slightly from 0 to 18 h of potato chip frying for each oil and showed no significant differences between oil types (Table 2).

Deterioration of the oils used for the potato chips was much less than of the oils used for french-fried potatoes because of greater turnover of oil in chip frying. After 15 h of oil use, TPC in oils for french-fried potatoes increased to levels that ranged from a low of 26.1% for HOSUN to 32.4% for CSO (Table 3). The European standard for deteriorated frying oils is 27% TPC (20). FFA levels increased from 0.1 to the 0.4–0.5 range in oils used for frying french-fried potatoes. FFA values between oil types were not significantly different at 0 and 15 h; however, significant differences were observed at 30 h.

Potato chips. The average specific gravity of the raw potatoes used for chips was 1.08. Moisture content for all potato chips ranged from 1.0 to 1.3%. Agtron units for color varied among oils from 53 to 57 on day 1 and from 49 to 52 on day 2.

Volatile compounds, including hexanal, pentanal, 2,4-decadienal, octanal, and nonanal, were used to monitor oxidation of the oil during potato chip storage. Previous work showed that these compounds are decomposition products of thermally oxidized triolein and trilinolein (21,22). Hexanal, pentanal, and 2,4-decadienal are products of linoleic acid oxidation, whereas octanal and nonanal are breakdown products from oleic acid oxidation (11). Volatile compounds were monitored in fresh potato chips fried in oils used for 3, 6, 12, and 15 h and in the same chips aged for 6 mon at 25°C. Data for the 3- and 6-h potato chips were similar as were results for 12- and 15-h samples; therefore, data shown for 6-h potato chips represented results from the first day of frying, and the 12-h samples represented samples from the second day of frying. Hexanal was the most prominent volatile compound in all aged potato chip samples; however, the levels of hexanal decreased with increasing oleic acid content (Figs. 1,2). Except for the sample fried in oil with 16% oleic/55% linoleic acid, the volatile compounds were at higher levels in the potato chips fried in 6-h oils than in 12-h oils. This agreed with results obtained previously, which showed that volatile compounds in potato chips were at higher levels when samples were fried during the earlier portion of the frying cycle, such as 6 h, or less than at 12 h or more (10). The level of linoleic acid in the frying oil affected the amounts of hexanal and pentanal measured in the aged potato chip samples. Both compounds decreased with decreasing linoleic acid; however, the effect was greater in potato chips fried in oils used for 12 h than for samples fried in 6-h oils (Figs. 1,2). Levels of octanal and nonanal increased slightly with increasing oleic acid

TABLE 2
Total Polar Compounds and Free Fatty Acid (FFA) Levels[a] in Oils Used to Fry Potato Chips (0, 12, and 18 h)

Oils	Polar compounds (%) (0 h)	(12 h)	(18 h)	FFA (%oleic) (0 h)	(18 h)
CSO	5.6a	8.9a	10.7a	0.10a	0.21a
67:33 CSO/HOSUN	4.5b	7.1b	9.5b	0.09a	0.22a
33:67 CSO/HOSUN	3.1c	6.5c	8.5c	0.10a	0.20a
HOSUN	2.9c	4.8d	7.9d	0.09a	0.21a

[a]Data in columns with letters in common are not significantly different ($P > 0.05$). See Table 1 for abbreviations.

TABLE 3
Total Polar Compounds and Free Fatty Acid (FFA) Levels[a] in Oils Used to Fry French-Fried Potatoes (0, 15, and 30 h)

Oils	Polar compounds (%) (0 h)	(15 h)	(30 h)	FFA (%oleic) (0 h)	(15 h)	(30 h)
CSO	5.6a	32.4a	42.5a	0.10a	0.24a	0.35a
67:33 CSO/HOSUN	4.5b	29.4b	39.6b	0.09a	0.24a	0.50c
33:67 CSO/HOSUN	3.1c	27.5c	37.9c	0.10a	0.23a	0.39ab
HOSUN	2.9c	26.1d	36.8d	0.09a	0.25a	0.42b

[a]Data in columns with letters in common are not significantly different ($P > 0.05$). See Table 1 for abbreviations.

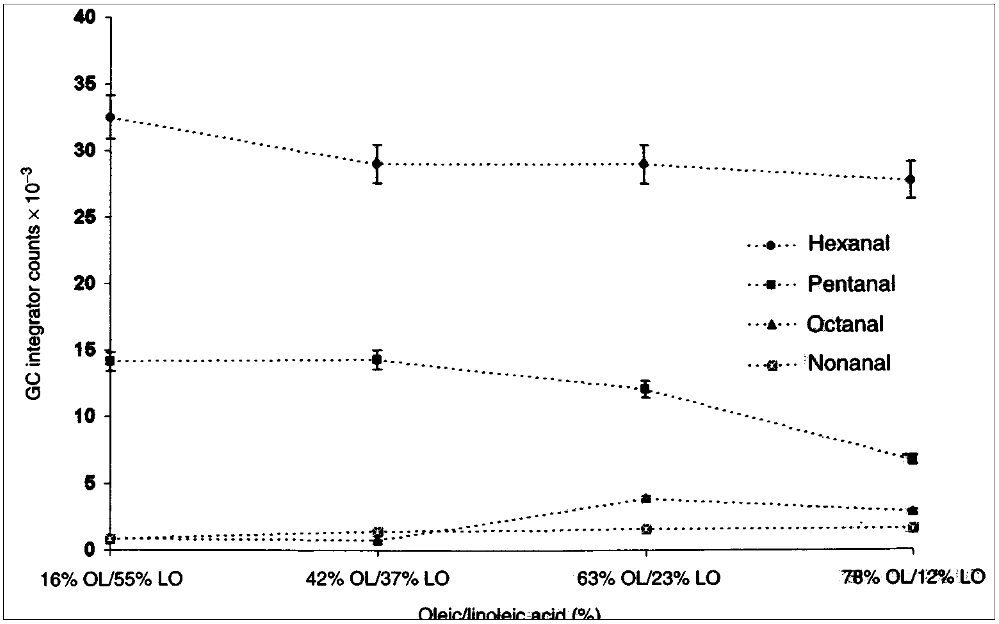

FIG. 1. Volatile compounds in potato chips fried in 6-h cottonseed oil (CSO), high-oleic sunflower oil (HOSUN), and blends of 67:33 CSO/HOSUN and 33:67 CSO/HOSUN and aged 6 mon at 25°C; GC, gas chromatographic; OL, oleic; LO, linoleic.

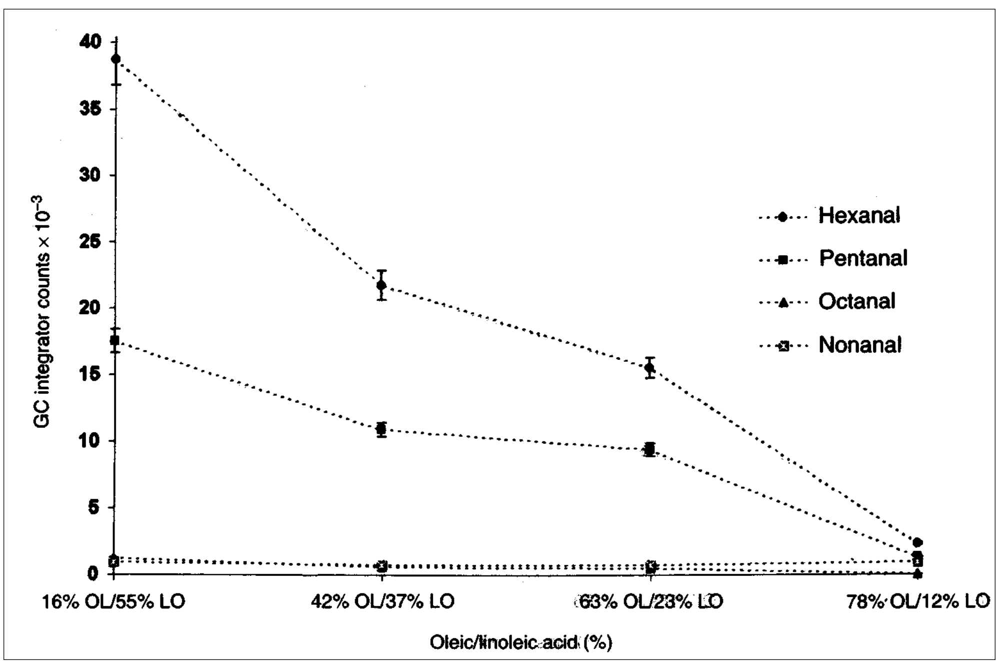

FIG. 2. Volatile compounds in potato chips fried in 12-h cottonseed oil (CSO), high-oleic sunflower oil (HOSUN), and blends of 67:33 CSO/HOSUN and 33:67 CSO/HOSUN and aged 6 mon at 25°C. See Figure 1 for other abbreviations.

in the potato chips fried in 6-h oils, but did not change significantly in the samples fried in 12-h oils. Levels of all volatile compounds were low in the unaged potato chips (data not shown). Hexanal and pentanal decreased with increasing oleic acid content, whereas nonanal increased slightly with increasing oleic acid.

Fried-food flavor intensity and overall flavor quality of fresh, unaged potato chips decreased as the percentage of oleic acid increased in the frying oils and as linoleic acid content decreased (Figs. 3,4). Stale, waxy, and fishy flavors in the fresh potato chips were detected only at weak levels. Potato chips fried in CSO with 16% oleic/55% linoleic acid had significantly higher intensity of fried-food flavor than potato chips fried in the oil with either 63% oleic/23% linoleic acid or 78% oleic/12% linoleic acid. Potato chips fried in 6-h or 12-h CSO had overall quality scores of 7.5–7.8 and fried-food flavor intensities of 5.4–5.9 (Figs. 3,4). Previous work showed that potato chips with moderate fried-food flavor intensity (intensity scores of 5.0–6.0) and with few or no off-flavors were rated high in overall flavor quality (quality scores of 7.0–8.0) (10). Potato chips stored at 25°C for 6 mon (Figs. 5,6) had a different pattern of fried potato flavor intensity and overall flavor quality than the unaged samples (Figs. 3,4). Aged potato chips fried in the oil blend with 42% oleic/37% linoleic acid had significantly higher fried-food flavor intensity than samples fried in CSO or HOSUN (Fig. 6). Lower fried-food flavor intensity in aged CSO chips than in fresh CSO chips could possibly be attributed to the presence of off-flavors, such as rancid, stale or fishy, in the aged sample. These results agreed with those of Fuller *et al.* (8) who showed that potato chips fried in CSO had less flavor stability than potato chips fried in high-oleic safflower oil.

Fatty acid composition of the oils significantly affected the intensity of the fried-food flavor in potato chips aged at 2, 4, and 6 mon at 25°C (Fig. 7). Data were pooled over frying time because few significant differences were noted in the fried-food flavor intensity of potato chips sampled at 3, 6, 12, and 15 h within the same oil type. Plotting means of pooled data for fried-flavor intensity showed that, as aging increased from 0 to 6 mon, fried-food flavor intensity decreased in all oils (Fig. 7). Initially, samples fried in CSO with 16% oleic/55% linoleic acid content had significantly greater intensities of fried-food flavor than potato chips fried in oils with 42% oleic/37% linoleic acid. The relationship of decreasing fried-food flavor intensity with increasing oleic acid content was apparent only at 0 and 2 mon of storage at 25°C. However, as aging increased to 4 and 6 mon, potato chips fried in oil with 42% oleic/37% linoleic acid had the highest level of fried-food flavor (Fig. 7). Off-flavors present in potato chips fried in CSO with higher levels of linoleic acid could possibly have masked the fried-food flavor of those chips.

Effect of 2,4-decadienal. Analysis of frying oil stability by TPC and analysis of oxidative stability of potato chips by volatile compounds showed that HOSUN oil with 78% oleic acid had the lowest levels of TPC (Table 2) and the lowest levels of hexanal and pentanal(Figs. 1,2), indicating greater frying oil stability (fry life) and oxidative stability of the food. However, potato chips fried in HOSUN had the lowest intensities of fried-food flavor (Figs. 3–7). 2,4-Decadienal, a breakdown product of linoleic acid oxidation, has been reported to affect the fried-flavor intensity of fried food (12). Therefore, 2,4-decadienal levels in the potato chips could partly explain the correlation between decreasing intensity of fried-food flavor in the potato chips and decreasing levels of linoleic acid in oils. Analysis of 2,4-decadienal in fresh and aged potato chips showed that isomers of this compound decreased significantly with increasing oleic acid content of the oil (Fig. 8). Significantly higher 2,4-decadienal levels in aged potato chips than in fresh samples, regardless of the oil type, might be expected because 2,4-decadienal has also been reported as a good marker for measuring oxidative stability (9). Effects of this compound on fried-flavor intensity of aged potato chips is complicated by reports in the literature that

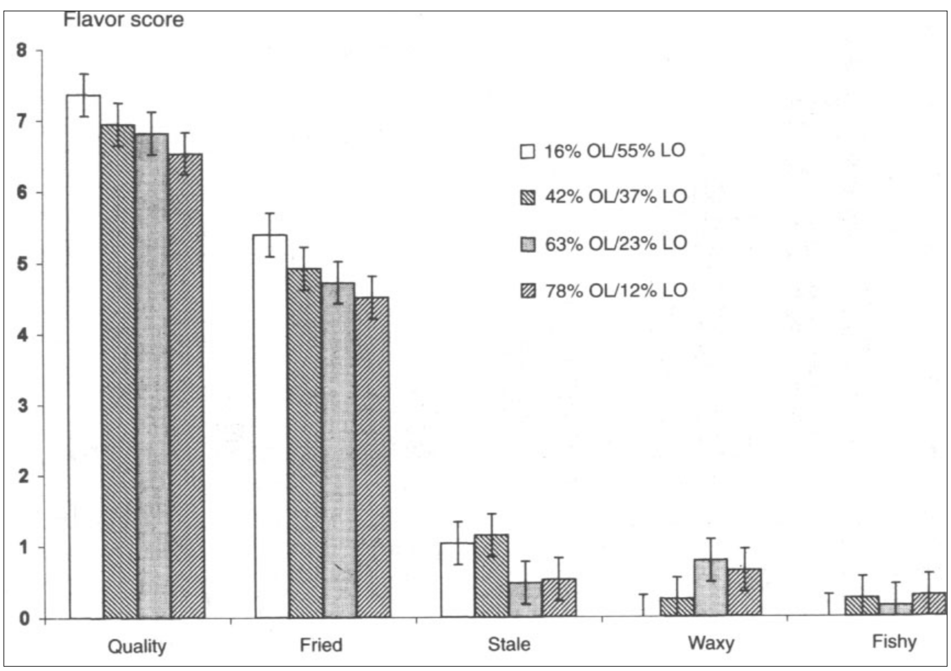

FIG. 3. Flavor analysis of unaged potato chips fried in 6-h cottonseed oil (CSO), high-oleic sunflower oil (HOSUN), and blends of 67:33 CSO/HOSUN and 33:67 CSO/HOSUN. Overall flavor quality: 1 = bad quality and 10 = excellent quality; individual flavor intensity scale: 0 = no intensity and 10 = strong flavor intensity. See Figure 1 for other abbreviations.

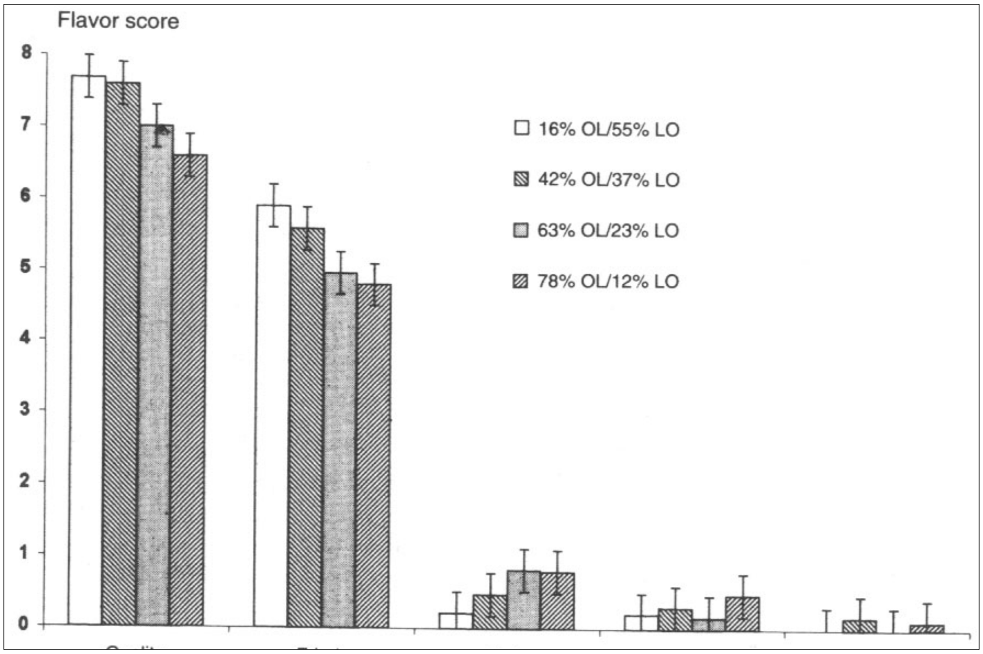

FIG. 4. Flavor analysis of unaged potato chips fried in 12-h cottonseed oil (CSO), high-oleic sunflower oil (HOSUN), and blends of 67:33 CSO/HOSUN and 33:67 CSO/HOSUN. Overall flavor quality: 1 = bad quality and 10 = excellent quality; individual flavor intensity scale: 0 = no intensity and 10 = strong flavor intensity. See Figure 1 for other abbreviations.

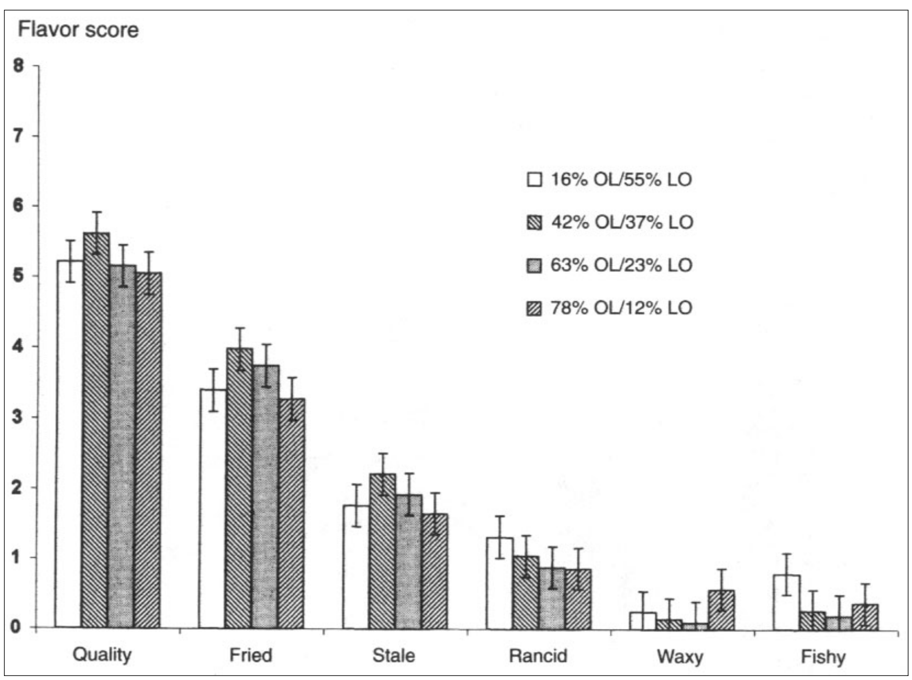

FIG. 5. Flavor analysis of potato chips fried in 6-h cottonseed oil (CSO), high-oleic sunflower oil (HOSUN), and blends of 67:33 CSO/HOSUN and 33:67 CSO/HOSUN and aged 6 mon at 25°C. Overall flavor quality: 1 = bad quality and 10 = excellent quality; individual flavor intensity scale: 0 = no intensity and 10 = strong flavor intensity. See Figure 1 for other abbreviations.

2,4-decadienal not only may be partly responsible for fried-food flavor (12) but also may indicate oxidation (9). Unfortunately, levels at which 2,4-decadienal is a desirable factor to contribute to fried-food flavor and levels at which it becomes indicative of rancidity are not known.

French-fried potatoes. Potatoes fried in 2-h oils (Fig. 9)

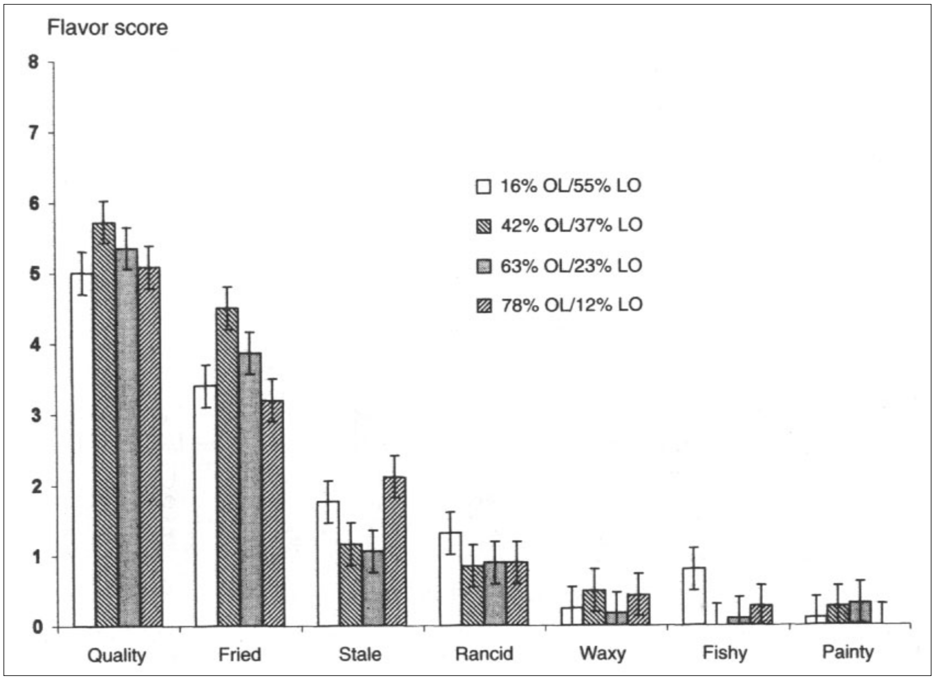

FIG. 6. Flavor analysis of potato chips fried in 12-h cottonseed oil (CSO), high-oleic sunflower oil (HOSUN), and blends of 67:33 CSO/HOSUN and 33:67 CSO/HOSUN and aged 6 mon at 25°C. Overall flavor quality: 1 = bad quality and 10 = excellent quality; individual flavor intensity scale: 0 = no intensity and 10 = strong flavor intensity. See Figure 1 for other abbreviations.

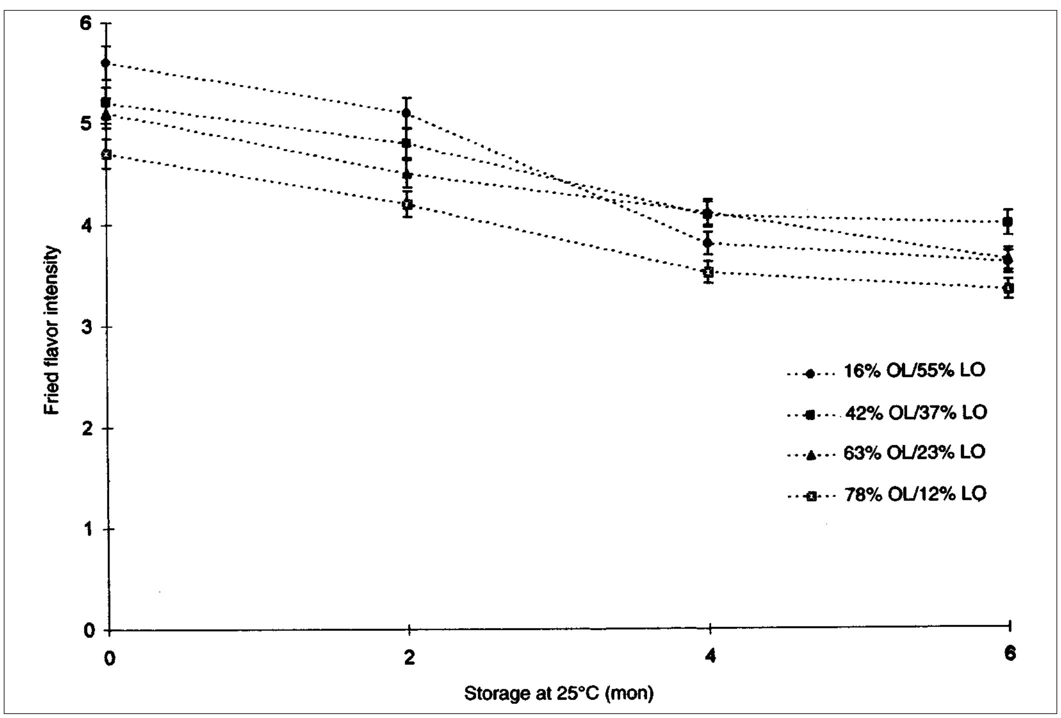

FIG. 7. Effect of oleic acid (OL)/linoleic acid (LO) levels in potato chips on mean scores for fried-flavor intensity pooled over 3-, 6-, 12-, and 15-h frying times. Individual flavor intensity scale: 0 = no intensity and 10 = strong flavor intensity.

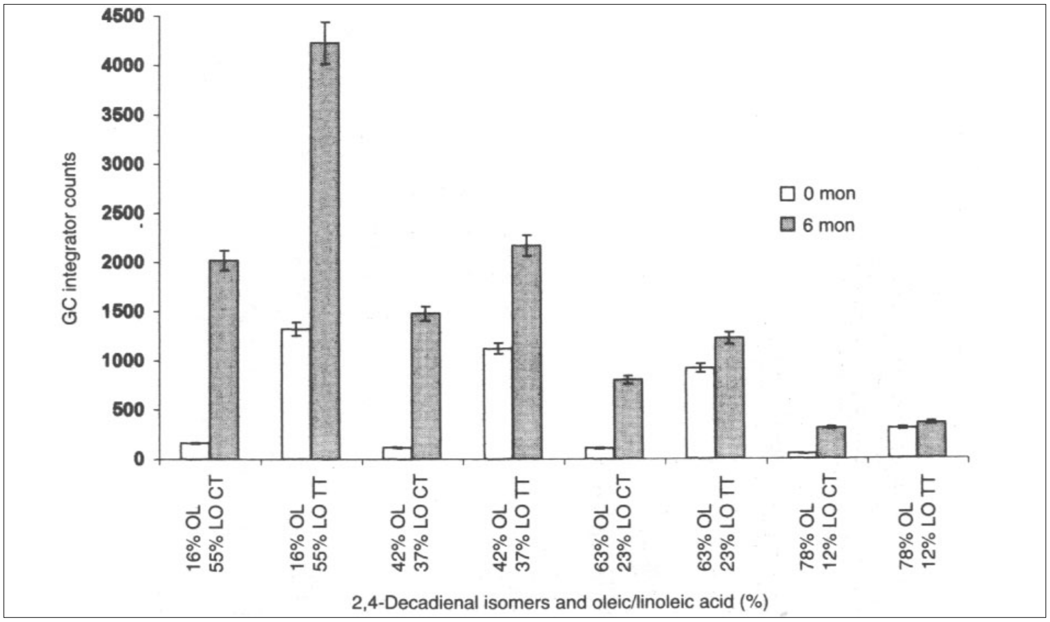

FIG. 8. 2,4-Decadienal in fresh and aged potato chips fried in 12-h cottonseed oil (CSO), high oleic sunflower oil (HOSUN), and blends of 67:33 CSO/HOSUN and 33:67 CSO/HOSUN. CT: *cis, trans.* TT: *trans, trans.* See Figure 1 for other abbreviations.

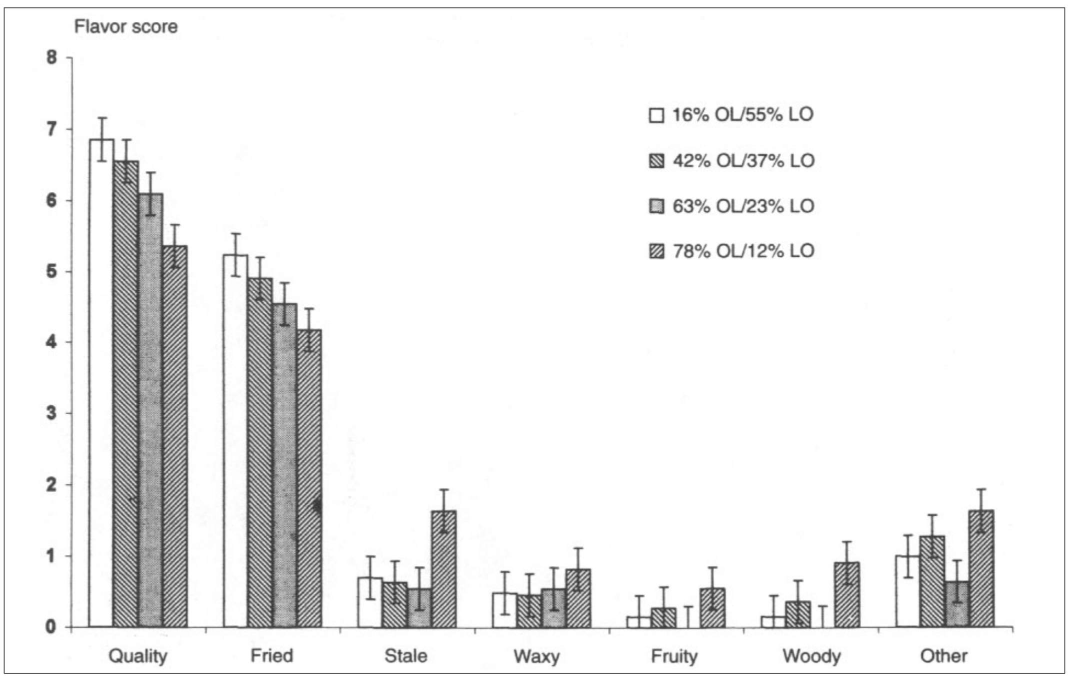

FIG. 9. Flavor analysis of french-fried potatoes fried in 2-h cottonseed oil (CSO), high-oleic sunflower oil (HOSUN), and blends of 67:33 CSO/HOSUN and 33:67 CSO/HOSUN. Overall flavor quality: 1 = bad quality and 10 = excellent quality; individual flavor intensity scale: 0 = no intensity and 10 = strong flavor intensity. See Figure 1 for abbreviations.

showed similar results to those obtained for unaged potato chips (Figs. 3,4). When either food was fried in fresh oil, fried-food flavor intensity and overall flavor quality decreased with increasing oleic acid content. However, french-fried potatoes fried in deteriorated 30-h oils showed that potatoes fried in oil with 63% oleic/23% linoleic had the highest fried intensity and the highest flavor quality score (Fig. 10). Plotting changes in fried-food flavor intensity over frying time for each oil separately indicated that HOSUN with 78% oleic/12% linoleic acid showed increasing fried-flavor intensity with increasing frying time (data not shown). Some of this effect can be examined by comparing the fried-food fla-

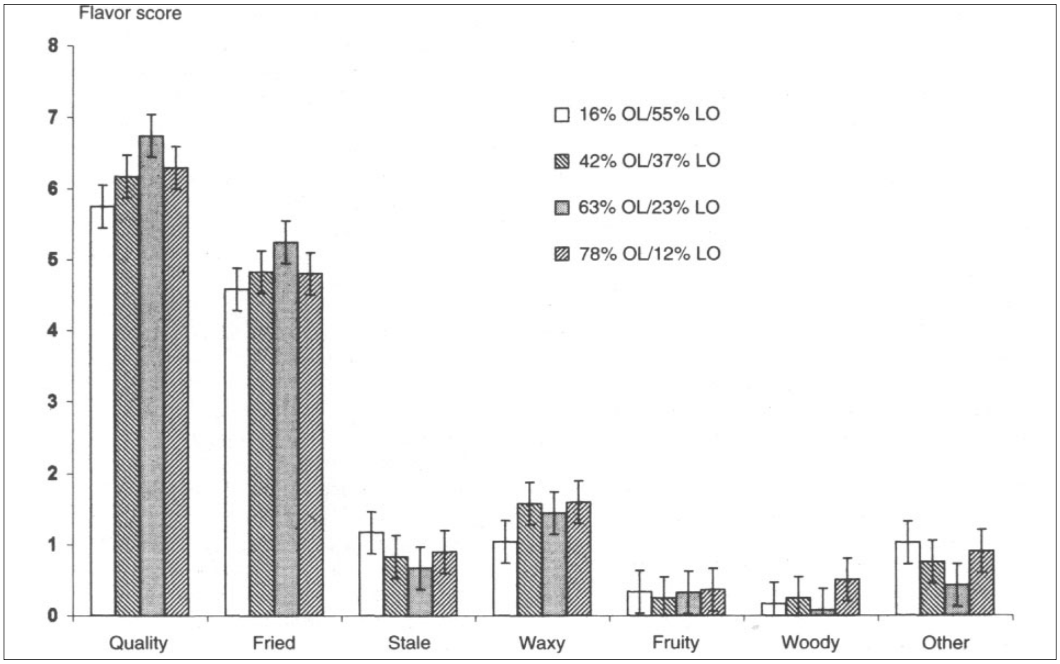

FIG. 10. Flavor analysis of french-fried potatoes fried in 30-h cottonseed oil (CSO), high-oleic sunflower oil (HOSUN) and blends of 67:33 CSO/HOSUN and 33:67 CSO/HOSUN. Overall flavor quality: 1 = bad quality and 10 = excellent quality; individual flavor intensity scale: 0 = no intensity and 10 = strong flavor intensity. See Figure 1 for abbreviations.

vor intensity score (4.1) for potatoes fried in 2-h HOSUN (Fig. 9) with the score (4.9) for samples fried in 30-h HOSUN (Fig. 10). The opposite effect occurred in the CSO with 16% oleic/55% linoleic acid in which fried-food flavor intensity decreased from 5.3 to 4.4 with increasing frying time from 2 h to 30 h. Although the fried-food flavor intensity was apparently the main component in determining overall flavor quality, off-flavors, such as stale (2-h oil only), waxy, fruity, and woody, were higher in the french-fried potatoes fried in HOSUN than in the other oils. The category of other off-flavors included metallic, toasted and acrid, and were detected at low intensity levels; they were combined into one group.

As indicators of oil fry life, TPC and FFA increased with increasing frying time, but only TPC increased proportionally with percentage linoleic acid in the oil. FFA was nondiscriminating as to fatty acid composition of the oils. HOSUN had significantly lower TPC than the other oils at the end of the frying cycles for both potato chips and french-fried potatoes. For fresh potato chips and french-fried potatoes, fried in fresh oil, fried-food flavor intensity was the best indicator of overall flavor quality. Percentage linoleic acid was the best predictor of flavor quality in fresh chips from this series of oils. Instrumental and chemical tests, including TPC and OSI, of the oils and volatile compounds in the chips varied directly with increasing oleic acid, and were therefore not indicative of flavor quality in fresh chips. For aged potato chips, no instrumental and chemical test was able to predict flavor stability of food. Results from all tests of oils and fried food did not agree because they were detecting different compounds. Therefore, knowing the chemical compounds that a method is measuring is important to understand the relationship of the analysis to fried-food quality and stability.

Fatty acid compositions of 16 to 42% oleic acid and 37 to 55% linoleic acid produced fresh-fried food with moderate levels of fried-food flavor, good overall flavor quality, and low to moderate levels (chips only) of TPC. However, in aged food or food fried in deteriorated oil, compositions of 42 to 63% oleic and 23 to 37% linoleic produced fried food with the best flavor stability.

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