EFFECTS OF OLEIC ACID LEVELS IN NUSUN MID-OLEIC SUNFLOWER OIL FROM 1996-1998 ON OIL STABILITY AND FRYING QUALITY

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Introduction

Oils for commercial frying must have appropriate compositions to help prevent deterioration at high temperatures. Modifying the fatty acid compositions of oils by breeding, by hydrogenating or by blending saturated and polyunsaturated oils have been used to create oils that have increased stability during frying. NuSun, a sunflower oil modified by traditional breeding has reduced levels of linoleic acid (C18:2) and increased levels of oleic acid (C18:1). Because the oleic acid content of NuSun has varied for the past several years, a study was conducted to determine the effects that different oleic acid levels have on the frying oil stability and fried food quality of NuSun. In addition, all oils are susceptible to oxidation during processing and storage before use; however, the effects of using oil oxidized before frying is not fully understood. Therefore, a study was conducted to measure the effects on frying quality in sunflower oil oxidized prior to deodorization.

Materials and Methods

Samples of refined, bleached, deodorized, winterized mid-oleic sunflower oil, NuSun, from harvest years 1996, 1997 and 1998 were obtained commercially. No oils contained additives other than citric acid. No. 1 Russet potatoes were obtained from a local market.
Fatty acid compositions of the oils were determined by capillary gas chromatographic (GC) analysis. Oxidative stability of the oils was measured by peroxide value (AOCS method Cd8-53) and by anisidine value (AOCS method Cd 18-90). The frying protocol included intermittent frying at 190°C with total heating/frying time of 20 hr. 800g of each oil was heated in 1 L. capacity fryers (Presto Industries, Model 2540, Eau Claire, WI) for 6-7 hr each day for 3 days. Fresh Idaho Russet potatoes were sliced, rinsed, blanched and fried in 150g batches. Each day, 80g of fresh oil was added as makeup oil to each fryer. Total polar compound level was determined in duplicate by the AOCS column chromatography method. Flavor of fresh and stored potato chips fried in the oils were evaluated by a 15-member trained, experienced analytical sensory panel.

Results

Effects of Oleic Acid Levels from 1996-1998 Harvest Years

The composition of the commercial oils used in this test showed that oleic acid levels

decreased from 75% in 1996 to 67% in 1997 to 60% in 1998 with corresponding increases in linoleic acid from 17% in 1996 to 33% in 1998 (Fig.1). Levels of palmitic and stearic acids varied only slightly.

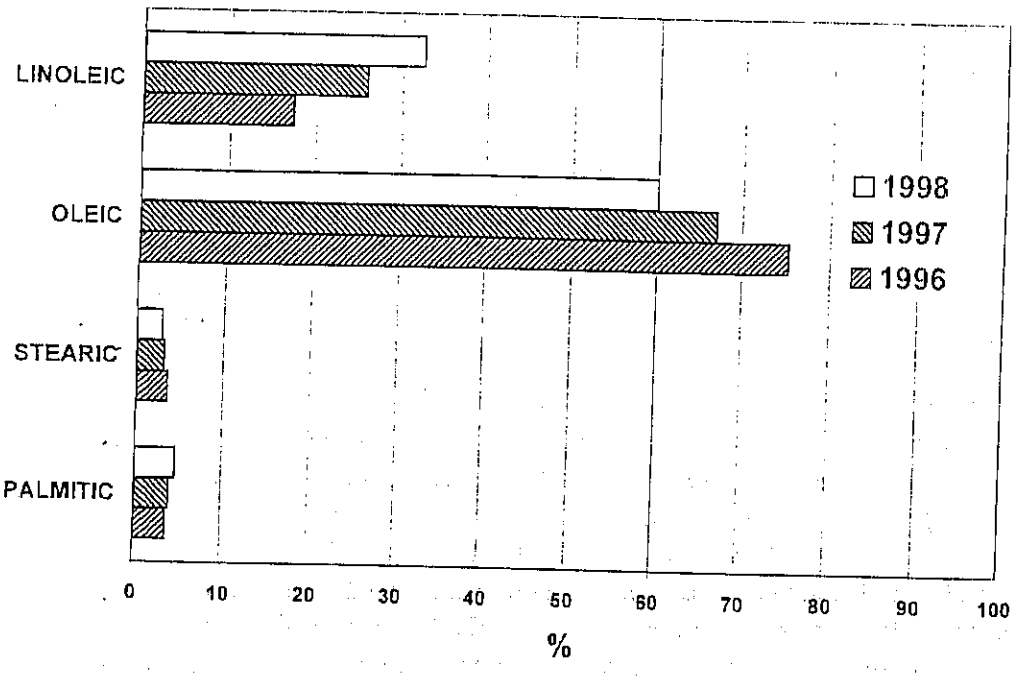

Fig. 1. Fatty Acid Composition of NuSun Sunflower Oils from 1996, 1997 and 1998 Harvest Years

The evaluation of overall flavor quality of the potato chips showed differences in fresh potato chips with the samples fried in oil containing 75% oleic acid having a significantly lower quality score than the scores for chips fried in the oils with 60% or 67% oleic acid (Fig. 2).

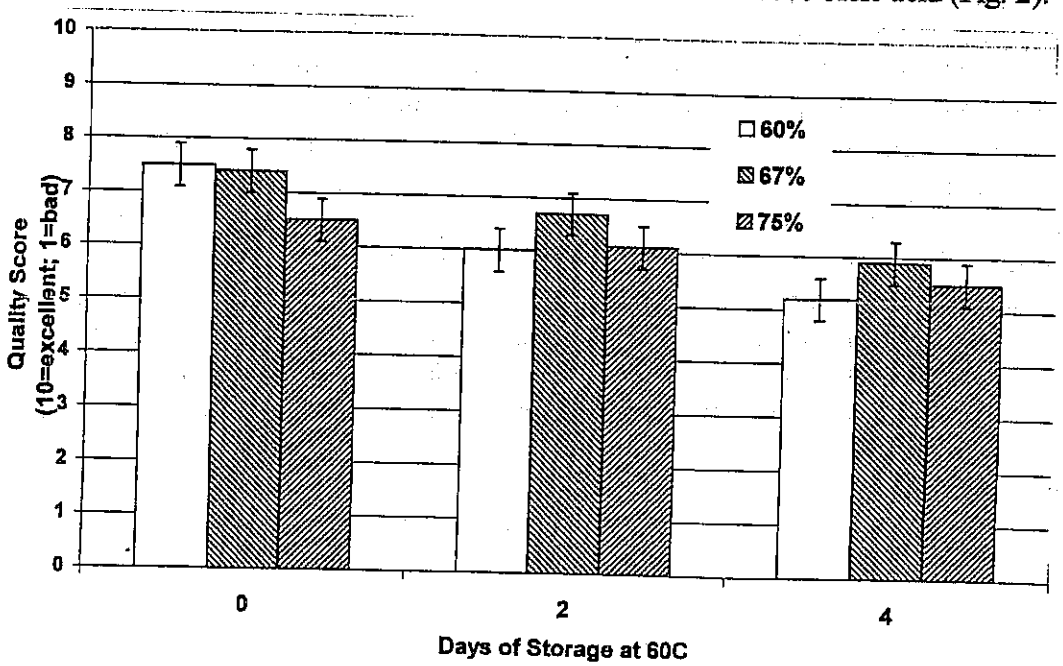

Fig. 2. Overall Quality Scores of Fresh and Aged Potato Chips Fried in NuSun Sunflower Oils with 60, 67 or 75% Oleic Acid at 5 Hours Frying

After the potato chips were aged 2 and 4 days at 60°C, no significant differences were noted between the chips fried in the oils with 60%, 67% or 75% oleic acid. The intensity level of fried food flavor in the potato chips was the primary reason for the differences in overall flavor quality of the fresh chips as shown in Fig. 3.

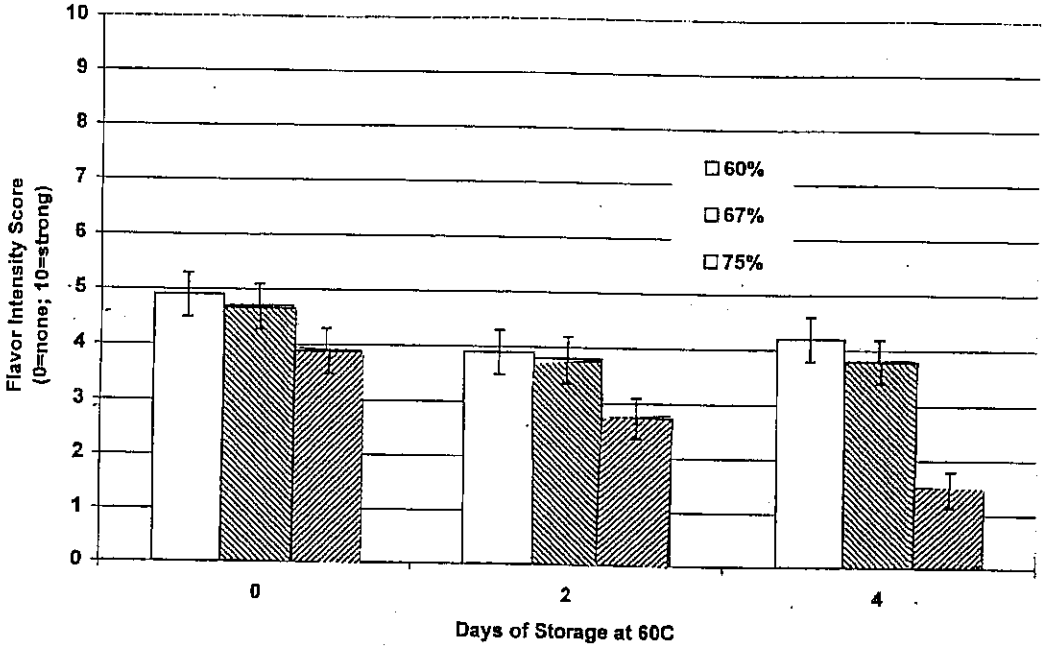

Fig. 3. Fried Food Flavor Intensity for Potato Chips Fried in NuSun Sunflower Oils with 60, 67 or 75% Oleic Acid at 5 Hours Frying

The intensity of fried food flavor decreased with increasing oleic acid content; however, the difference between chips fried in 60% and 67% oleic acid levels was not significant. The intensity of rancid flavor in the aged potato chips decreased with increasing oleic acid level (Fig. 4); however, the differences were not significantly different between oleic acid levels.

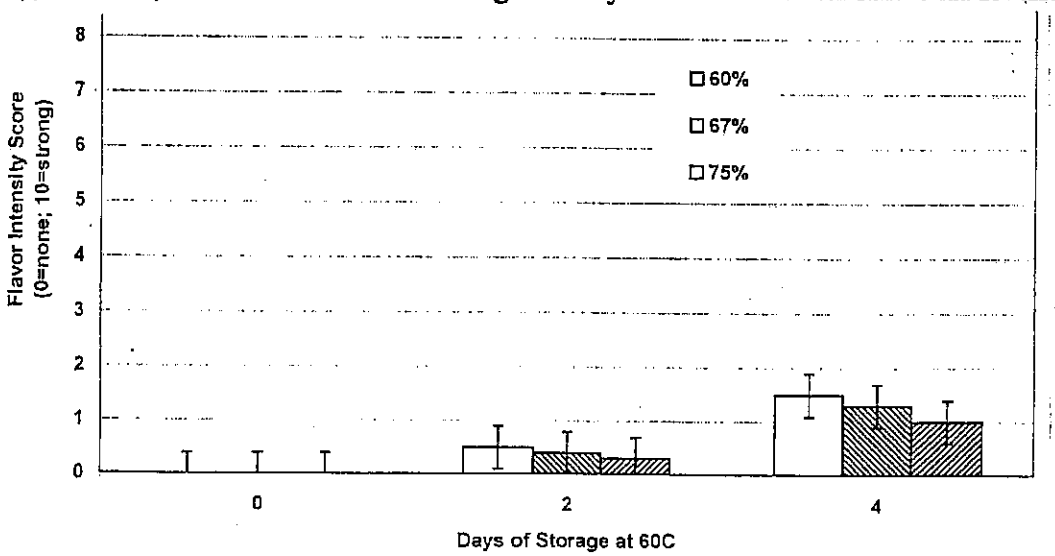

Fig. 4. Rancid Flavor Intensity for Fresh and Aged Potato Chips Fried in NuSun Sunflower Oils with 60, 67 or 75% Oleic Acid at 5 Hours Frying

The analysis of total polar compounds, a chemical test to measure the level of deterioration in a frying oil, showed no differences in the amount of deterioration in any of the oils after 5 hours of frying (Fig. 5). On the other hand, the oil with 75% oleic acid had significantly lower less total polar compounds than the oil with 60% oleic acid after 20 hours of frying. In conclusion, at the 5 hour frying time, frying oil stability and potato chip rancidity was not significantly different between NuSun oils with 60%, 67% and 75% oleic acid. Fried food flavor intensity decreased with increasing levels of oleic acid. Overall flavor quality of the potato chips was highest in the oil with 67% oleic acid. Based on frying oil stability and quality of potato chips in this study, a NuSun oil with 67% oleic acid is recommended for frying.

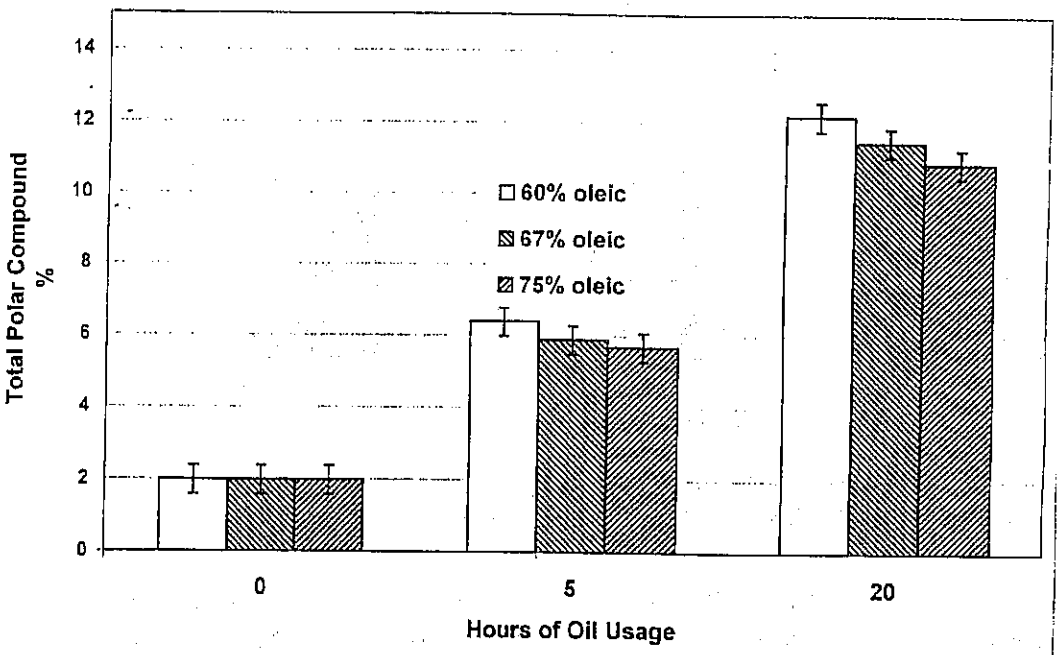

Fig. 5. Total Polar Compounds in NuSun Sunflower Oils with 60, 67 or 75% Oleic Acid Used to Fry Potato Chips for 0, 5 and 20 Hours

Effects of Prior Oxidation in Oils on Frying Quality and Oil Stability

Commercial samples of NuSun were evaluated that had initial peroxide values less than 1.0 but with low (4.7) and high anisidine (8.9) values. The oil with the higher anisidine value had probably been oxidized prior to or during processing, but the peroxides formed during oxidation were removed during deodorization resulting in a low peroxide value, but leaving the nonvolatile oxidation products that react in the anisidine test. Oxidation products measured by the anisidine test may act as catalysts for further oxidation in the fully processed oil. To study possible effects of high anisidine values on oil stability, oil was aged at 60°C for 0, 2, 4, 6, and 8 days and evaluated for peroxide value. At all storage times except 0 days, the oil with the high anisidine value of 8.9 was significantly lower in stability than the oil with the low anisidine value of 4.7 (Fig. 6).

The two oils with low and high anisidine values were also used to fry potato chips as described in the previous study. No significant differences were noted between potato chips fried in the oils with the low and high anisidine values when the chips were evaluated without aging (Fig. 7).

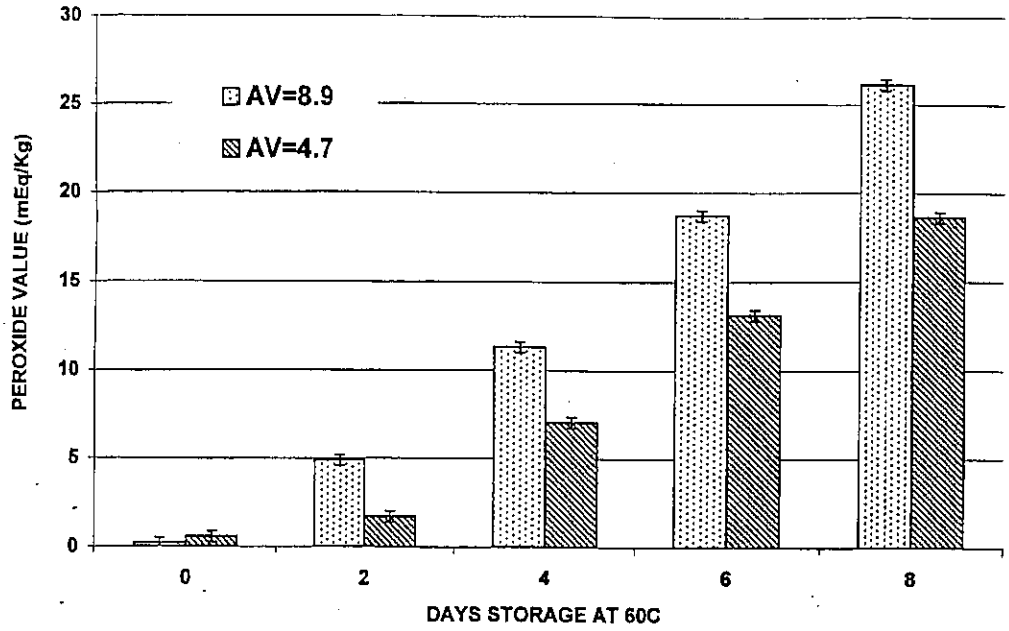

Fig. 6. Peroxide Values of 1998 NuSUN oils: Effects of Variations in Initial Anisidine Values

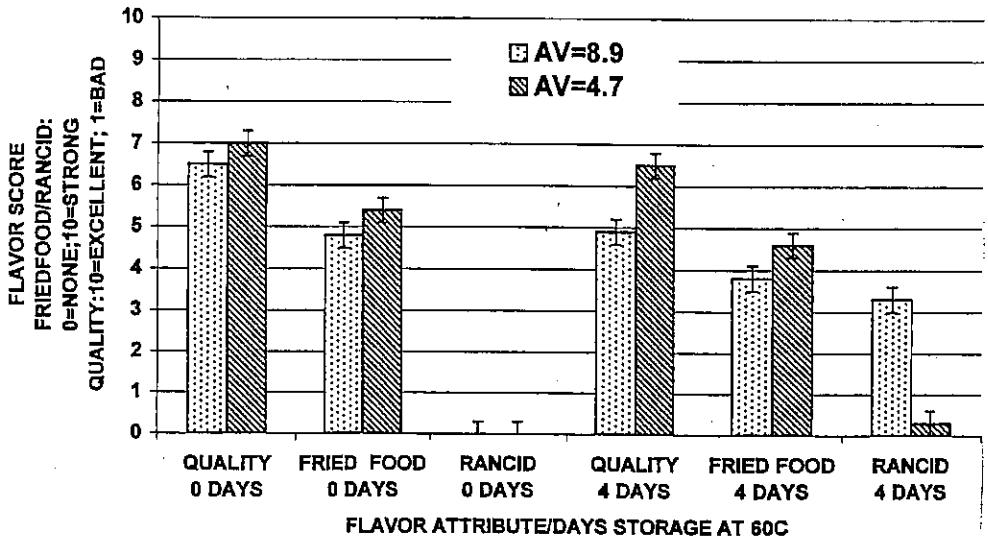

Fig. 7. Flavor Scores of Potato Chips Fried in 1998 NuSUN oil: Effects of Variations in Initial Anisidine Values

However, the potato chips fried in the oil with the low anisidine value had significantly better quality and lower rancidity than chips fried in the oil with high anisidine value after aging for 4 days at 60°C. In conclusion, salad oils and frying oils should have little or no oxidation prior to use as evaluated by anisidine value. Oils should be evaluated for anisidine value or non-volatile secondary oxidation products in addition to peroxide value to help determine their future stability in food uses.

References

AOCS, American Oil Chemists' Society Official Methods and Recommended Practices, 5th Edition, 1998, Champaign, IL.