

## **NUSUN Frying Test (1997 Crop)**

**Project:** To compare the frying stability of NUSUN (Mid Oleic Sunflower Oil) to that of a Creamy Liquid Frying Shortening (104 IV PHSBO).

**Procedure:** Four 6.8 kg Star Electric Fryers were filled with 6.8 kilograms of respective Oil;

Fryer 1 - NUSUN  
Fryer 2 - 104 IV PHSBO  
Fryer 3 - 104 IV PHSBO  
Fryer 4 - NUSUN

Frying temperature was set to maintain the oil at  $175^{\circ}\text{C} \pm 3.0^{\circ}\text{C}$  twenty four hours a day for eight days. Each day 4.6 kilograms of water blanched, frozen potato cubes were deep fried. Oil samples were taken at the end of each day of frying. Oil was added back to maintain a consistent oil level.

**Analysis:** Oil samples were analyzed by the following tests;

Free Fatty Acid - AOCS Official Method Ca 5a-40.  
Oxidative Stability Index - AOCS Official Method Cd 12b-92.  
Hunter Color - In house objective color measurement.  
Hunter Difference to a White Plate - In house objective color measurement.  
Hunter Difference to Fresh Oil - In house objective color measurement.  
para Anisidine Value - AOCS Official Method Cd 18-90.  
Total Polar Materials - In house analytical procedure.

**Results:** Table 1 contains the results of the fresh oil analysis. Table 2 contains the results of the daily evaluation of the fryers. Table 3 contains the results of the used oil analysis. Table 4 contains the results of trace metal analysis on the used oil samples. Figures 1 through 6 graphically depict the data from table 3.

Table 1: Fresh Oil Comparisons

| Analysis            | NUSUN (97 Crop) | 102-050 (021698D) |
|---------------------|-----------------|-------------------|
| Lovibond Yellow     | 8               | 12.0              |
| Lovibond Red        | 0.8             | 0.2               |
| FFA (% C18:1)       | 0.05            | 0.05              |
| IV by RI            | 101.9           | 104.1             |
| GLC C16:0           | 4.6             | 10.5              |
| C18:0               | 4.2             | 6.7               |
| C18:1               | 61.3            | 43.6              |
| C18:2               | 27.3            | 34.9              |
| C18:3               | 1.1             | 3.5               |
| OSI hrs. @ 110°C    | 33.6            | 35.2              |
| $\alpha$ Tocopherol | 213.9           | 70.4              |
| $\beta$ Tocopherol  | 4.5             | 9.2               |
| $\gamma$ Tocopherol | 3.8             | 651.3             |
| $\delta$ Tocopherol | 0               | 219.5             |
| Total Tocopherol    | 222.2           | 950.4             |
| Trace Metals (ppm)  |                 |                   |
| Phosphorous         | <0.5            | <0.5              |
| Nickel              | <0.05           | 0.3               |
| Copper              | <0.05           | <0.05             |
| Iron                | 0.1             | <0.05             |
| Magnesium           | 0.1             | <0.05             |
| Calcium             | 0.3             | <0.05             |
| Silicon             | 1.0             | 1.4               |
| Silicone (DMPS)     | 3.6             | 3.7               |

Table 2: Daily Comments and Notes

| Fryer | Oil Odor                                  | Potato Flavor          | Oil Top Off (g) | Oil Temp. (°C) | Comments   |
|-------|---|------------------------|-----------------|----------------|--|
| F1 D1 | Phenolic                                  | Clean                  | 300             | 174.4          | Phenolic oil odor                                  |
| F2 D1 | Melon                                     | Clean                  | 300             | 174.3          | More intense heated odor                           |
| F3 D1 | Melon                                     | Clean                  | 300             | 175.5          | More intense heated odor                           |
| F4 D1 | Phenolic                                  | Clean                  | 300             | 174.4          | Phenolic oil odor                                  |
| F1 D2 | Clean, heated odor                        | Bland                  | 300             | 172.6          | Clean potato flavor                                |
| F2 D2 | clean, heated odor<br>slight more intense | More fried food flavor | 300             | 172.8          | sl. stronger heated odor<br>More fried food flavor |
| F3 D2 | Clean, heated odor<br>Slight more intense | More fried food flavor | 300             | 175.7          | Sl. stronger heated odor<br>More fried food flavor |
| F4 D2 | Clean, heated odor                        | Bland                  | 300             | 174.5          | Clean potato flavor                                |
| F1 D4 | Heated odor                               | Clean                  | 300             | 172.6          | Sl. more polymer on sides                          |
| F2 D4 | More heated odor                          | Clean                  | 300             | 172.5          | nothing off  |
| F3 D4 | More heated odor                          | Clean                  | 300             | 174.1          | nothing off  |
| F4 D4 | Heated odor                               | Clean                  | 300             | 172.4          | Sl. more polymer on sides                          |
| F1 D6 | Clean, heated odor                        | clean, bland           | 900             | 175.1          | Sl. more polymer on sides                          |
| F2 D6 | Strong heated odor                        | sl. sweet              | 900             | 173.0          | nothing off  |
| F3 D6 | Strong heated odor                        | sl. sweet              | 900             | 174.2          | nothing off  |
| F4 D6 | Clean, heated odor                        | clean, bland           | 900             | 173.7          | sl. more polymer on sides                          |
| F1 D8 | Clean, heated                             | bland flavor           | --              | 175.8          | sl. foam   |
| F2 D8 | Strong heated odor                        | more oil flavor        | --              | 175.4          | sl. foam   |
| F3 D8 | Strong heated odor                        | more oil flavor        | --              | 175.8          | sl. foam   |
| F4 D8 | Clean, heated                             | bland flavor           | --              | 174.9          | sl. foam   |

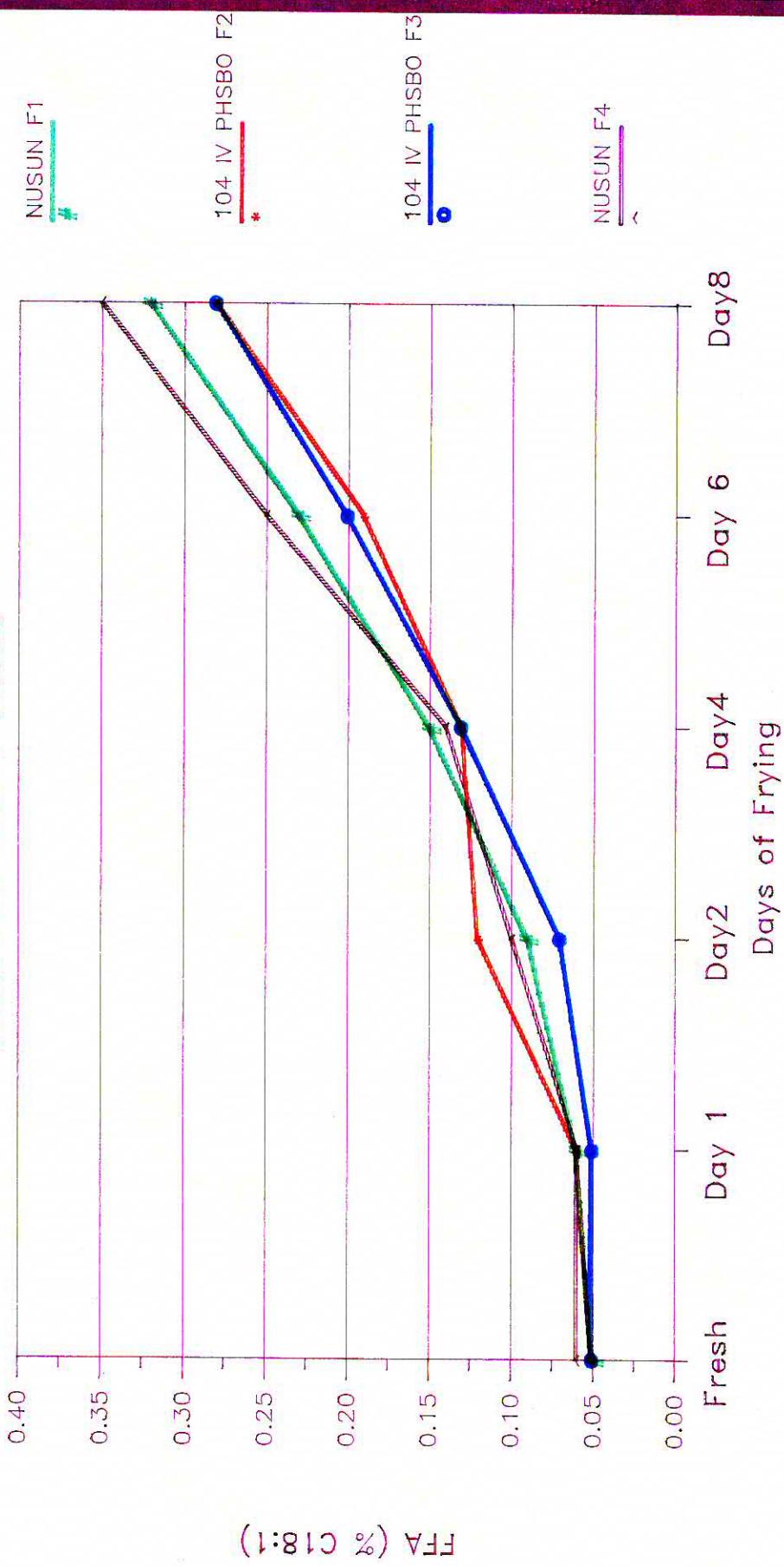
Table 3: Used Frying Oil Analysis

| Sample | FFA<br>%C18:1 | P-AV | Hunter<br>1,a,b | Hunter<br>DEW | Hunter<br>DEO | OSI<br>@<br>110°C | Total<br>Polars<br>(%) |
|--------|---------------|------|-----------------|---------------|---------------|-------------------|------------------------|
| F1 F   | 0.05          | 3.8  | 49.9,-2.8,8.6   | 43.7          | 0             | 33.5              | 2.05                   |
| F2 F   | 0.05          | 0.4  | 50.6,-1.6,4.2   | 42.3          | 0             | 34.1              | 1.43                   |
| F3 F   | 0.05          | 0.3  | 50.5,-1.7,4.3   | 42.4          | 0             | 36.2              | --                     |
| F4 F   | 0.06          | 3.7  | 50.0,-2.8,8.6   | 43.6          | 0             | 33.7              | --                     |
| F1D1   | 0.06          | 19.8 | 47.6,-2.6,11.8  | 46.6          | 3.9           | 19.2              | --                     |
| F2D1   | 0.06          | 19.8 | 47.8,-2.6,11.0  | 46.2          | 7.4           | 22.2              | --                     |
| F3D1   | 0.05          | 23.4 | 47.7,-2.9,11.4  | 46.4          | 7.7           | 19.8              | --                     |
| F4D1   | 0.06          | 20.1 | 47.4,-2.6,12.3  | 46.9          | 4.5           | 17.1              | --                     |
| F1D2   | 0.09          | 45.5 | 46.0,-2.9,16.5  | 49.5          | 8.8           | 9.6               | 7.73                   |
| F2D2   | 0.12          | 50.0 | 45.5,-3.1,17.2  | 50.2          | 14.0          | 14.3              | 6.50                   |
| F3D2   | 0.07          | 51.7 | 44.9,-3.1,17.7  | 51.0          | 14.6          | 13.3              | --                     |
| F4D2   | 0.10          | 45.1 | 45.2,-2.7,17.0  | 50.4          | 9.7           | 9.8               | --                     |
| F1D4   | 0.15          | 57.1 | 43.2,-2.0,20.1  | 53.4          | 13.3          | 8.8               | 10.42                  |
| F2D4   | 0.13          | 64.8 | 42.3,-1.5,21.2  | 54.6          | 18.9          | 12.5              | 9.59                   |
| F3D4   | 0.13          | 66.4 | 41.1,-0.8,21.3  | 55.7          | 19.4          | 12.5              | --                     |
| F4D4   | 0.14          | 55.5 | 42.2,-1.4,20.5  | 54.4          | 14.3          | 9.0               | --                     |
| F1D6   | 0.23          | 64.3 | 39.9,1.0,23.1   | 57.6          | 18.0          | 7.5               | 14.77                  |
| F2D6   | 0.19          | 76.9 | 39.0,2.4,23.2   | 58.5          | 22.6          | 10.3              | 13.69                  |
| F3D6   | 0.20          | 77.4 | 37.2,3.3,22.8   | 60.1          | 23.3          | 10.0              | --                     |
| F4D6   | 0.25          | 62.4 | 38.9,1.7,22.8   | 58.4          | 18.6          | 6.6               | --                     |
| F1D8   | 0.32          | 61.4 | 37.4,4.2,23.1   | 60.1          | 20.4          | 6.6               | 17.17                  |
| F2D8   | 0.28          | 72.9 | 36.3,5.3,22.8   | 61.1          | 24.5          | 10.1              | 16.06                  |
| F3D8   | 0.28          | 74.5 | 34.8,6.8,22.0   | 62.3          | 25.1          | 11.1              | --                     |
| F4D8   | 0.35          | 59.4 | 36.7,4.7,22.9   | 60.7          | 20.9          | 6.5               | --                     |

Table #4: Trace Metal Analysis on Used Oil Samples

| Sample | P ppm | Ni ppm | Cu ppm | Mg ppm | Ca ppm | Fe ppm | Si ppm |
|--------|-------|--------|--------|--------|--------|--------|--------|
| F1D1   | 0.6   | <0.05  | <0.05  | 0.1    | 0.3    | 0.1    | 0.3    |
| F2D1   | 0.6   | 0.2    | <0.05  | 0.1    | 0.1    | <0.05  | 0.3    |
| F3D1   | 0.9   | 0.2    | <0.05  | 0.1    | 0.1    | <0.05  | 0.3    |
| F4D1   | 0.5   | <0.05  | <0.05  | 0.1    | 0.3    | 0.1    | 0.3    |
| F1D8   | 1.3   | <0.05  | <0.05  | 0.2    | 0.3    | <0.05  | 0.7    |
| F2D8   | 1.5   | 0.1    | <0.05  | 0.1    | 0.2    | <0.05  | 0.2    |
| F3D8   | 2.2   | 0.2    | <0.05  | 0.2    | 0.2    | <0.05  | 0.2    |
| F4D8   | 1.7   | <0.05  | <0.05  | 0.2    | 0.3    | <0.05  | 0.3    |

**FREE FATTY ACID (%C18:1)**  
**NUSUN vs. 104 IV PHSBO**



Expressed as % Oleic Acid

FIGURE #1

**p-Anisidine Value**  
**NUSUN vs. 104 IV PHSBO**

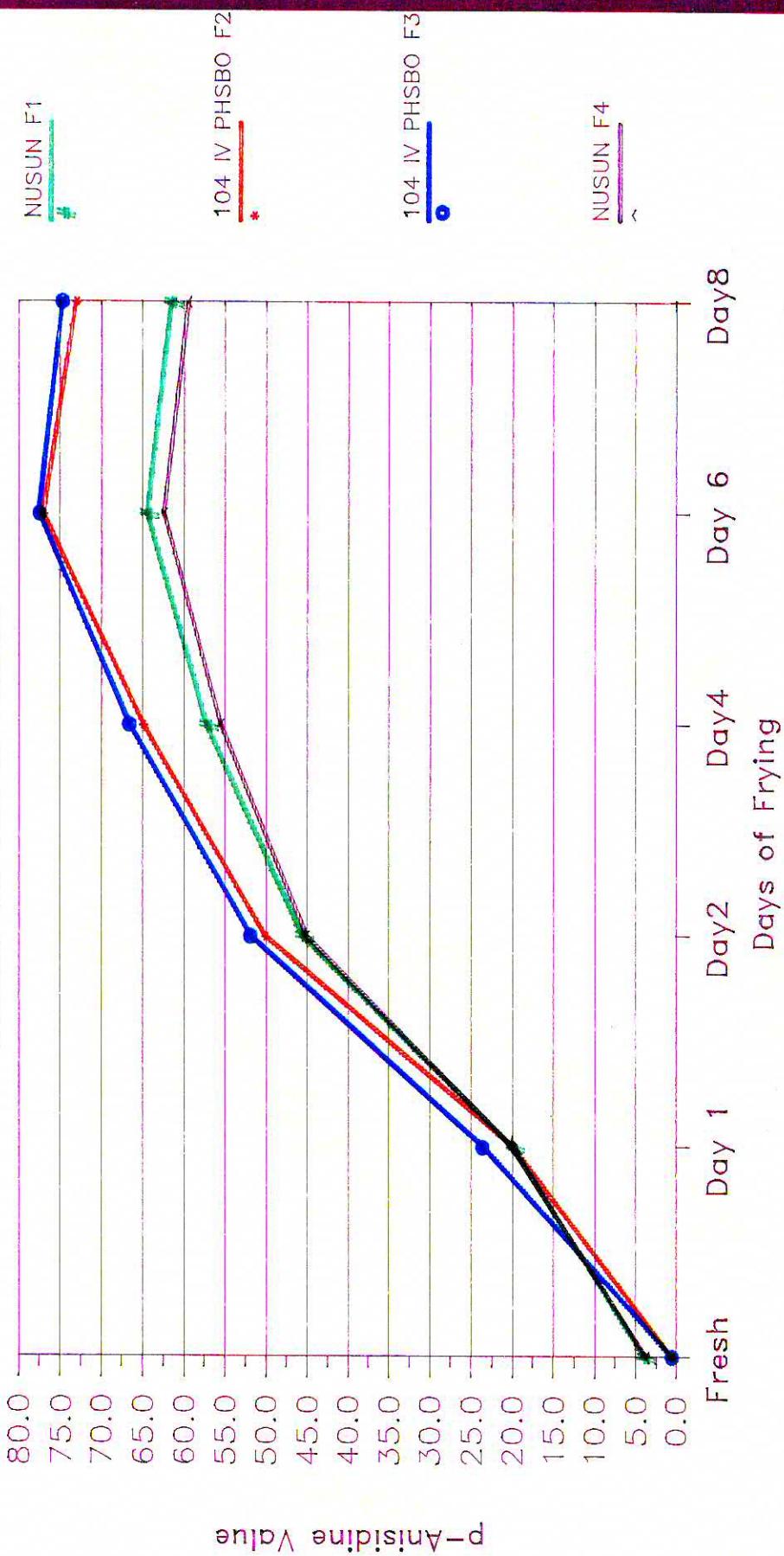


FIGURE #2

Hunter DEW  
NUSUN vs. 104 IV PHSBO

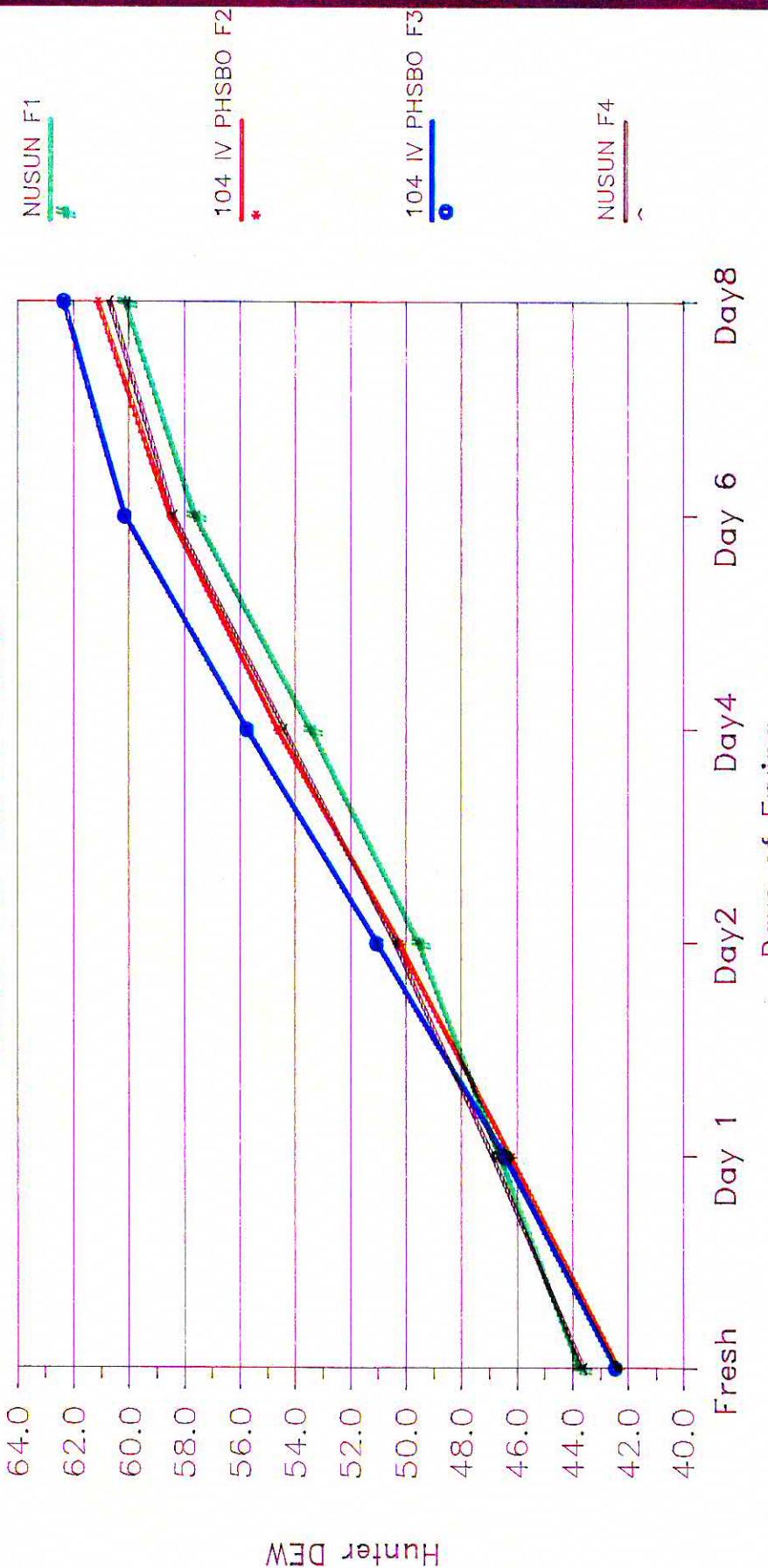


FIGURE #3

Hunter DEW, 0 = white, 100 = black

### Comparison to Fresh Oil

Hunter DEO  
NUSUN vs. 104 IV PHSBO

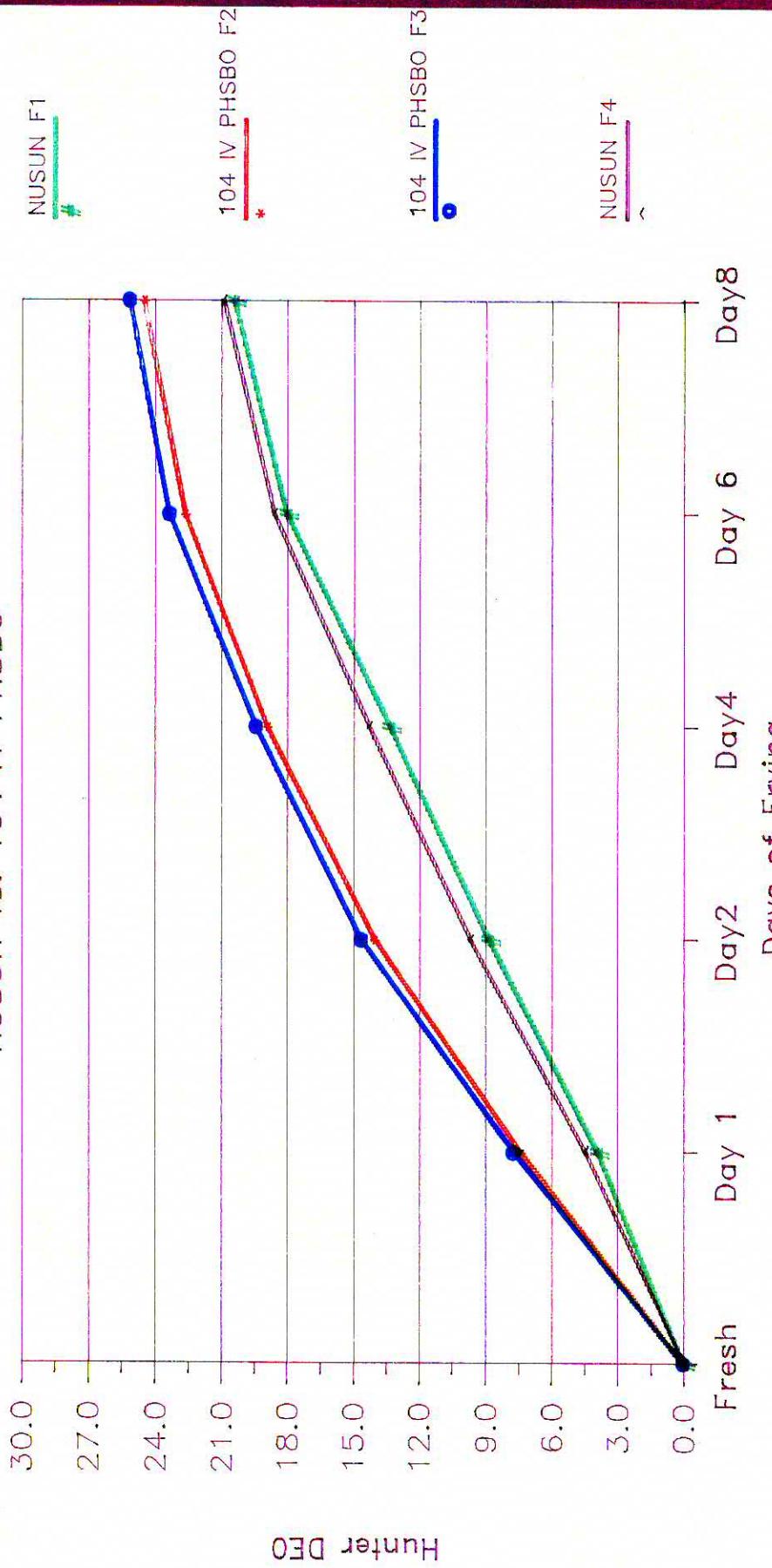


FIGURE #4

**OXIDATIVE STABILITY INDEX**  
NUSUN vs. 104 IV PHSBO

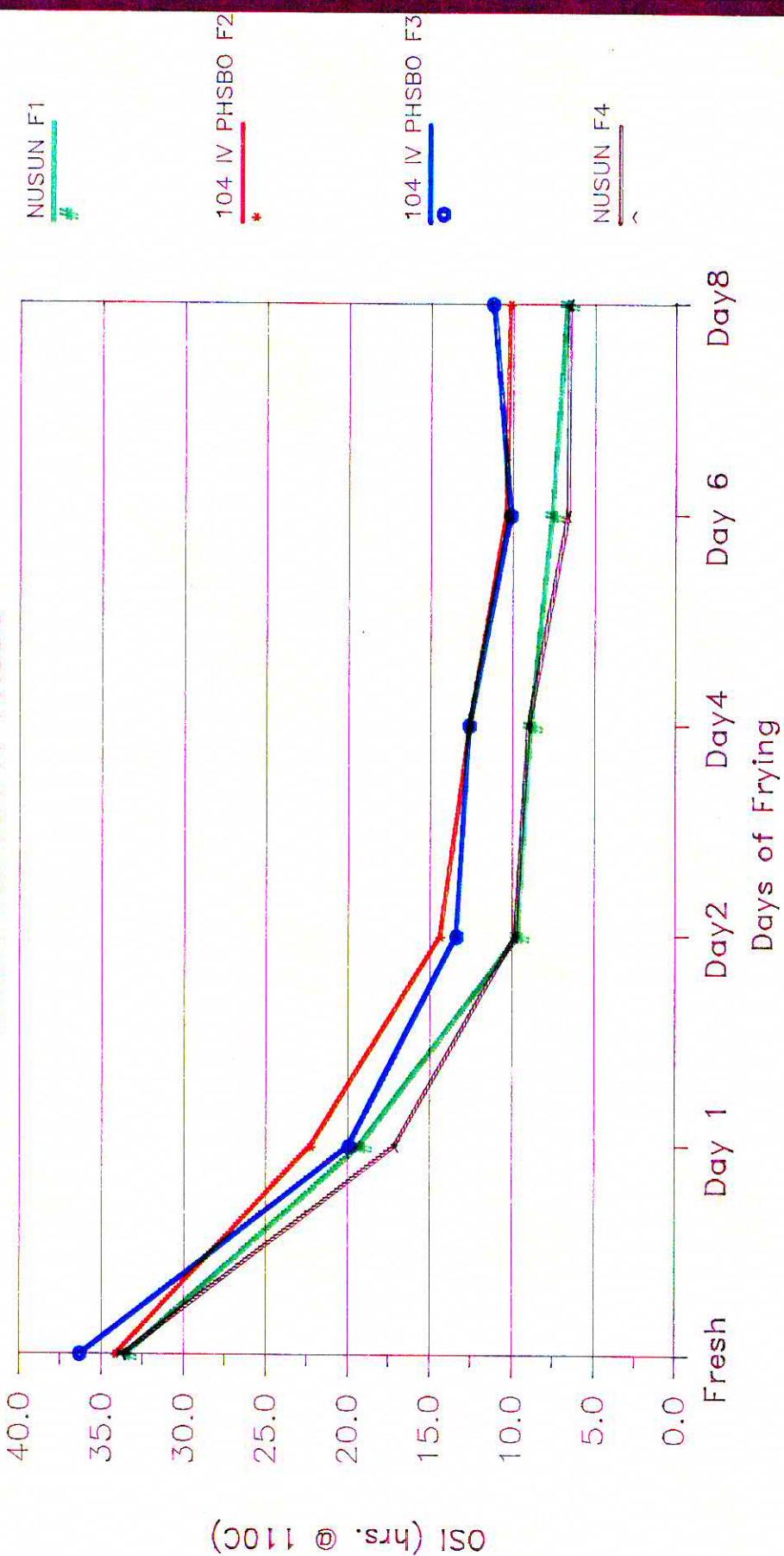
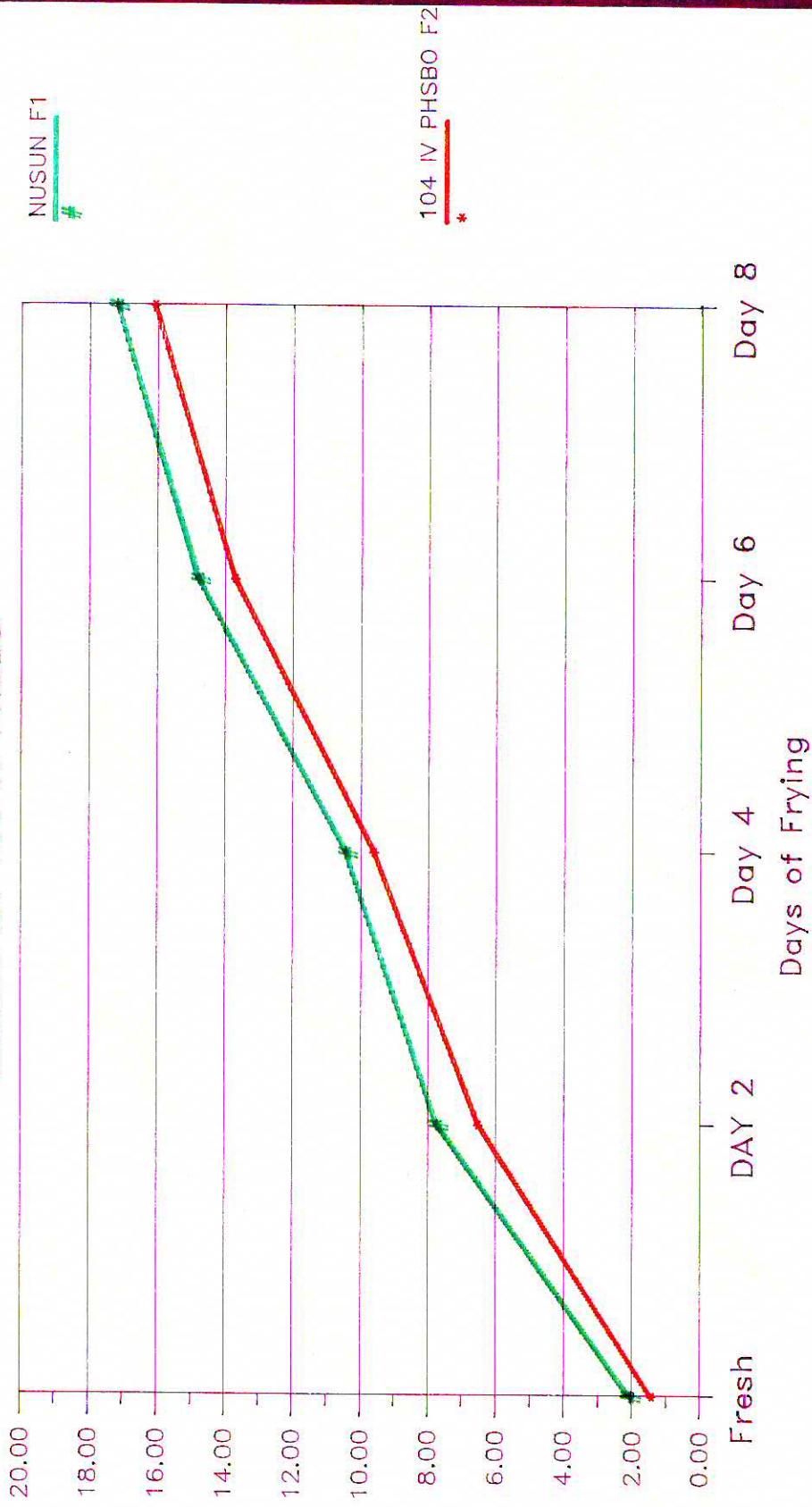


FIGURE #5

# TOTAL POLAR MATERIAL ANALYSIS (%)

NUSUN vs. 104 IV PHSBO



% TOTAL POLARS

FIGURE #6

**Conclusions:** Following are conclusions made from the evaluation of the data generated during the frying test.

◎**Frying Stability** - NUSUN proved to exhibit equal frying stability to that of the 104 IV Partially Hydrogenated Soybean Oil.

◎**Color Stability** - NUSUN exhibited less color formation, Restauranteur's use color as a means by which to evaluate oil quality.

◎**Flavor Stability** - Potato cubes fried in NUSUN developed a more pleasing fried food flavor.

◎**Nutritional Profile** - The nutritional profile of the NUSUN is much more favorable than that of the Partially Hydrogenated Soybean Oil;

NUSUN = 9.0% saturated fatty acids, and less than 1.0% trans fatty acids.

104 IV PHSBO = 17.0% saturated fatty acids, and ≈15.0% trans fatty acids.