TABLE II

Comparison of the Quantity of Minor Constituents from Mixed Commercial Oleic Acid and Mixed Beef Tallow (%)

| | Total minor constituents | Effective minor constituents | | | | Total effective minor constituents |
|---|---|---|---|---|---|---|
| | | EA | EN | MA | MN | |
| Mixed commercial oleic acid | 1.18 | 0.27 | 0.12 | 0.04 | 0.02 | 0.45 |
| Mixed beef tallow | 1.09 | 0.10 | 0.07 | 0.02 | 0.02 | 0.21 |

### Origin of the Minor Constituents in Commercial Oleic Acid

Similar minor constituents with similar chemical functional groups and similar effects on the color stability of purified oleic acid during heating were found in both commercial oleic acid (2) and in fatty acids produced from beef tallow in the laboratory (Table I and Fig. 2-5). Since the fatty acids were prepared from beef tallow in the laboratory under an inert atmosphere at temperatures no higher than 100 C, it is reasonable to assume that a portion of the minor constituents in the commercial oleic acid was originally present in the raw material, beef tallow.

The comparison of the amount of the minor constituents isolated from the MCOA and the MBT is shown in Table II. There was a total of 1.18% minor constituents in the MCOA, and only 1.09% in the MBT. Furthermore, the total amount of the minor constituents which could effect the darkening of oleic acid during heating was 0.45% in the MCOA and only 0.21% in the MBT. This indicated that the minor constituents in the MCOA were not entirely present in the raw material, the MBT. They might be partly produced during the manufacturing process.

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# Qualitative and Quantitative Comparison of Minor Constituents in Different Commercial Oleic Acids[1]

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## ABSTRACT

The minor constituents from a high quality commercial oleic acid (SCOA) were isolated and fractionated by liquid column chromatography. They were chemically characterized and their effects on the color stability of oleic acid during heating were determined. The results were compared qualitatively and quantitatively with those from a mixture of commercial oleic acids (MCOA) manufactured by 10 companies. It was found that, qualitatively, SCOA and MCOA contained the same type of minor constituents. However, quantitatively, the MCOA contained 1.18% of minor constituents whereas the SCOA contained only 0.81% of minor constituents. The amount of effective minor constituents which had an adverse effect on the color stability of oleic acid during heating was 0.09% for SCOA vs 0.45% for MCOA.

## INTRODUCTION

We reported in our previous papers (1-3) that commercial oleic acid contains minor constituents which can be isolated by a silicic acid column method. The minor constituents have been fractionated by gradient elution liquid column chromatography and the fractions characterized. It was found that the minor constituents had an adverse effect on the color stability of oleic acid. When added to purified oleic acid in trace amounts, they could increase the darkening of the oleic acid during heating.

This paper reports the qualitative and quantitative comparison between the minor constituents isolated from a single commercial oleic acid of the highest quality and

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those isolated from a mixture of commercial oleic acids of various qualities.

## EXPERIMENTAL PROCEDURES

### Materials Used

A commercial oleic acid (SCOA) manufactured from fancy beef tallow by a company was used. The oleic acid was the best grade of commercial oleic acids produced by that company.

### Isolation and Fractionation of Minor Constituents from SCOA

The procedures for the isolation and fractionation of minor constituents from SCOA were the same as those used previously (2,3).

### Analytical Methods

Analytical methods for iodine value, acid value, saponification value, hydroxyl value, carbonyl value, molecular weight, elemental analyses, infrared spectra and color stability were the same as those used previously (2,3).

### Effects of Fractions on the Color Stability of Purified Oleic Acid (POA)

The color stability was determined according to the method of Lin et al. (1). A subfraction of minor constituents was arbitrarily regarded as an effective subfraction when it caused an increase in color intensity of 20 units/0.1% of added subfraction of minor constituents into purified oleic acid (POA) when measured spectrophotometrically at 440 mμ after heating at 200 C under air for 1 hr.

## RESULTS AND DISCUSSION

### Characterization of Minor Constituents

The minor constituents in the SCOA were isolated and fractionated into 53 subfractions by stepwise gradient chromatography in exactly the same manner as described previously for a mixed commercial oleic acid (2,3). These minor constituents could cause darkening of purified oleic acid during heating, in the same manner as the minor constituents of MCOA (Table I).

Functional group analyses of the selected subfractions of the minor constituents isolated and fractionated from the SCOA (Tables II and III) showed that they are similar in chemical nature to the minor constituents isolated from the MCOA.

TABLE I

Effectiveness in Causing Darkening of POA during Heating by Fractions of Minor Constituents from SCOA

| Fractions | Concentration added (%) | Photometric index reading | |
|---|---|---|---|
| | | 440 mμ | 550 mμ |
| Y-A-1-1 | 0.075 | 34 | 6.0 |
| Y-A-1-4 | 0.075 | 45 | 7.0 |
| Y-A-1-5 | 0.075 | 48 | 7.5 |
| Y-A-1-6 | 0.075 | 70 | 11.0 |

TABLE III

Elemental Composition of the Analyzed Fractions of SCOA

| Fraction | Composition (%) | | |
|---|---|---|---|
| | C | H | O |
| Y-A-1-1 | 77.55 | 12.27 | 9.18 |
| Y-A-1-4 | 65.71 | 9.72 | 24.57 |
| Y-A-1-5 | 66.12 | 9.77 | 24.11 |
| Y-A-1-6 | 62.09 | 9.08 | 28.84 |

### Quantitative Comparisons

SCOA which is a commercial oleic acid of the highest quality contained 0.81% of minor constituents. On the other hand, the MCOA which is a mixture of oleic acid of various qualities contained 1.18%. The amount of minor constituents which could cause darkening of purified oleic acid during heating was only 0.09% for SCOA, but 0.45% for MCOA. This indicates that the commercial oleic acids manufactured by different companies with different methods may contain minor constituents of similar chemical nature. However, different grades of commercial oleic acid manufactured by different companies may contain different amounts of minor constituents.

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TABLE II

Characterization of the Subfractions of Minor Constituents of SCOA

| Fraction | Molecular formula | Molecular weight | -COOH Molecule | -COOR Molecule | -OH Molecule | -C=O Molecule | -C=C- Molecule | No. of oxygen atoms unaccounted for |
|---|---|---|---|---|---|---|---|---|
| Y-A-1-1 | $C_{18}H_{34}O_2$ | 283 | 0.98 | 0.05 | 0.16 | 1.18 | – | 0 |
| Y-A-1-4 | $C_{18}H_{34}O_5$ | 351 | 0.95 | 0.51 | 0.49 | 0.92 | 0.31 | 1.28 |
| Y-A-1-5 | $C_{25}H_{34}O_7$ | 457 | 1.06 | 0.75 | 1.20 | 1.45 | 0.28 | 1.90 |
| Y-A-1-6 | $C_{34}H_{60}O_{11}$ | 655 | 2.18 | 2.30 | 1.01 | – | – | 1.03 |