

A Simple and Efficient Method to Distinguish Mineral Oils from Vegetable Oils

Tarun Mehta and Andre C. Siegel

Purpose: An economic and efficient method was established for the separation and semi-quantitation of mineral and vegetable oils.

Introduction: Mineral oils and/or vegetable oils are commonly used in a variety of commercial products including industrial lubricants, food products, cosmetics, and pharmaceuticals. Mineral oil is the liquid by-product of the distillation of petroleum. Vegetable oils are lipids derived from plants, which are composed of triglycerides. Both products are fairly non-polar with mineral oil being more non-polar than triglycerides. In this application note a thin layer chromatography (TLC) protocol was established to accurately separate and semi-quantify various vegetable and mineral oils as well as some commercial products.



Figure 1. Products used for TLC analysis.

Methodology: Samples were separated with TLC. This requires the sample to be applied to a stationary phase: a thin layer of absorbent fixed to a plate. The bottom edge of the plate is then dipped in a solvent, referred to as the mobile phase, and the solvent is then drawn up via capillary action. This is responsible for the separation of samples. A silica gel with aluminum backing was used as the stationary phase (5cm x 10cm). Six different organic solvents in various concentrations were analyzed. Of the samples tested satisfactory separation was achieved with a mobile phase consisting of 80% toluene and 20% chloroform (v/v). Samples at 1% for vegetable oils, 5% for mineral oils and 5% for commercial products were dissolved in dichloromethane (w/w). The plates were spotted with 2 µl for vegetable oil and commercial products (4 µl for Johnson's Baby Oil) and 1 µl spots for mineral oil samples. Samples were visualized by submerging plates into 10% H₂SO₄, allowed to dry and finally heated for 20 mins @ 120°C. Semi-quantitation was calculated using the retention factor (RF): a ratio of the distance the spot has moved (measured at leading edge) divided by the distance the solvent migrated (solvent front) from the starting point (origin).

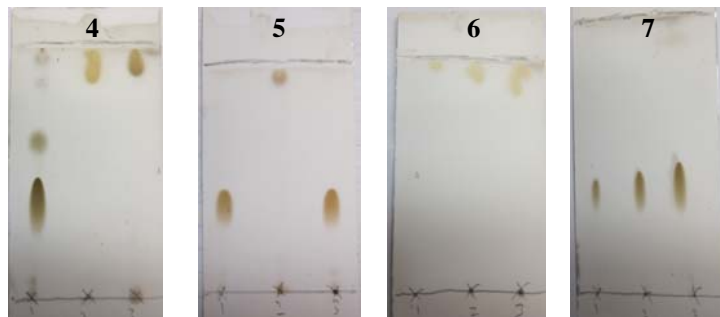
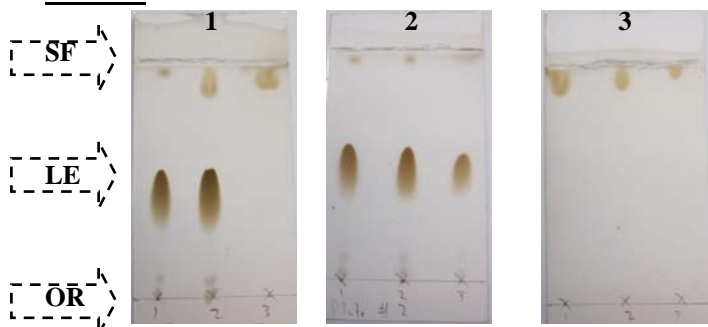
Results:

Figure 2. TLC plates of vegetable oil, mineral oil and commercial products.

Table 1. TLC plates spotting order and retention factor (RF) for each spot

Plate	Spot 1	RF	Spot 2	RF	Spot 3	RF
1	Canola Oil (Vg)	.46	50/50 of Vg and MO Oil	.46, .96	MO (Life Brand)	.96
2	Canola Oil (Vg)	.57	Corn Oil (Vg)	.55	Sunflower Oil (Vg)	.53
3	MO (Life Brand)	.99	MO (SA)	.99	Light MO (SA)	.99
4	Tom's Secret Formula	.46	Johnson's Baby Oil	.98	Moto Master Motor Oil	.98
5	Kraft Vinegar Salad dressing	.43	WD-40 lubricant	.97	Kraft Miracle Whip	.43
6	MO (Life) 20 µg	.99	MO (Life) 40 µg	.99	MO (Life) 60 µg	.99
7	Sunflower Oil (Vg) 1 µg	.43	Sunflower Oil (Vg) 5 µg	.44	Sunflower Oil (Vg) 10 µg	.47

SF – Solvent Front
LE – Leading Edge
OR – Origin

Vg – Vegetable Oil
MO – Mineral Oil
SA – Sigma Aldrich brand

Conclusion Once optimized, the TLC protocol was an effective and inexpensive method for the separation and semi-quantitation of vegetable and mineral oils. Vegetable oil samples separate on the plates with a RF of approximately 0.5 whereas mineral oil samples migrate very closely with the solvent front, RF ~1.0. Plates 1 to 3 demonstrate the differential separation of the two types of oil. Plates 6 and 7 illustrate the semi-quantitative nature of TLC; plate 6 shows the minimum amount of mineral oil that can be spotted for detection, approximately 25 µg (order of spots from left to right: 20, 40 & 60 µg); plate 7 shows the minimum amount of vegetable oil that can be spotted for detection is close to 1 µg (order of spots from left to right: 1, 5, & 10 µg). Microgram calculations for the oil samples are approximate and were based on the density of water (1000 µg/µl); the calculations are semi-quantitative and overlook differences in density between different oil samples. The results using pure oil samples (plates 1-3) showing distinct RF values for vegetable versus mineral oils reliably identified oils in commercial products (plates 4 and 5) as either vegetable or mineral: Kraft Vinegar Salad dressing, and Kraft Miracle Whip contain vegetable oils whereas Johnson's Baby oil, Moto Master Motor oil, and WD-40 lubricant contain mineral oils. Our results would suggest that Tom's Secret Formula a biodegradable lubricant, is composed of vegetable oil.