APPLICATION NOTE - ANALYZING ESSENTIAL OIL COMPOSTION AND PURITY

Application Need: It is difficult to ensure the quality and purity of essential oils, because they are complex mixtures of many different chemical constituents, and can be affected by growing and harvesting conditions, distillation technique, handling, and storage conditions. In addition, products can pass through many hands before reaching the consumer, and some unscrupulous distillers or sellers alter essential oils by diluting, cutting, or extending them, while selling them as “pure.”

Solution: Use Reichert’s polarimeters, refractometers, and density meters to measure an essential oil, identifying its composition and purity.

Overview

An **essential oil** is a liquid that is generally distilled (most frequently by steam or water) from the leaves, stems, flowers, bark, roots, or other elements of a plant. Essential oils, contrary to the use of the word "oil," are not really oily-feeling at all. Most essential oils are clear, but some oils such as patchouli, orange, and lemongrass are amber or yellow in color.

There are a few techniques available for analyzing essential oil composition and purity, but there is no technique that can absolutely guarantee an oil’s composition and purity. There are three common quality control methods for checking essential oils, all of which involve measuring physical parameters: polarimetry, refractometery, and density. All three are quick, non-destructive measurement methods.

Method 1: Measuring Specific Rotation Using Polarimetry

The **specific rotation** of a substance is defined as the optical rotation of a solution containing 1 g/ml in a 100 mm polarimeter tube. It is affected by temperature (20°C reference temperature) and wavelength (usually the sodium D line, 589 nm, is used), and can be measured by a Reichert polarimeter, which uses the following formula:

$$[\alpha]_D^{20} = \frac{\alpha}{c \cdot d}$$

where:

α is the measured optical rotation
d the light path in dm
c the concentration as g/ml

Fill a clean, 100 mm-long polarimeter tube with the diluted (or pure) essential oil. Place the filled sample tube in the polarimeter and record the measured value. Compare the calculated value with the expected value.

Specific rotations of some essential oils:

Substance	Specific Rotation (at 589 nm, 20°C)
Lemon Oil	+ 57° to + 70°
Mint Oil	- 17° to - 24°
Orange Oil	+ 94° to + 99°
Spearmint Oil	- 45° to – 60°

Product Recommendations:

Polar3 Polarimeter – Reichert Cat #14003000

Polar1 Polarimeter – Reichert Cat #14001000

Method 2: Measuring Refractive Index

The refractive index of an essential oil is a unique number that designates how the oil responds to and bends light. Essentially, it is a measurement that tests how the speed of light is altered when passing through the oil. An oil's refractive index can be compared to that of a reliable sample.

Refractive indices of some essential oils:

Substance	Refractive Index RI (at 589 nm, 20°C)
Lemon Oil	1.474 to 1.476
Lavender Oil	1.459 to 1.464
Orange Oil	1.470 to 1.474
Spearmint Oil	1.455 to 1.460
Rose Oil	1.451 to 1.484

Product Recommendations:

AR9 Refractometer – Reichert Cat #14009000

AR5 Refractometer -– Reichert Cat #14007000

Method 3: Measuring Gravity (Specific Gravity)

Measured using a *densitometer*, the specific gravity of an essential oil is a unique number that measures the density of a particular oil in comparison with the density of water. Specific gravity readings are measured at precise temperatures and pressures, as temperature and pressure can impact the measurements. Particular oils have known ranges of specific gravity in which the oil is considered to be unadulterated and pure.

Substance	Specific Gravity
Lemon Oil	0.849 to 0.855
Lavender Oil	0.870 to 0.880
Orange Oil	0.842 to 0.846
Spearmint Oil	0.917 to 0.934
Rose Oil	0.848 to 0.861

Product Recommendations:

Density4 Density Meter Reichert Cat # 14004000
Measure densities to accuracy of 0.0001 g/cm3

Density5 Density Meter – Reichert Cat #14005000
Measure densities to accuracy of 0.00005 g/cm3