Polarimeter / Refractometer

Analysing essential oil composition and purity

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.

Essential oils are complex mixtures of many different chemical constituents. The composition of a given oil can be affected by every step in production, including growing and harvesting conditions, distillation technique, essential oil handling and storage conditions. In addition, some unscrupulous distillers or sellers alter essential oils by diluting, cutting, or extending them, and then sell them as “pure.”

Given all of these factors, it can be extremely difficult to ensure the quality of an essential oil, because it may have passed through many hands before it reaches the consumer. There are a few techniques for analyzing essential oil composition and purity, but bear in mind that there is no technique available which can analyze an oil so thoroughly as to absolutely guarantee its composition and purity.

Common quality standard for essential oils is to measure the physical parameters. One physical parameter is the specific rotation which can be determined very simple, fast and non-destructive by polarimetry. A second is the Refractive Index which can be measured by refractometry.

1. Polarimetry

The specific rotation 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:

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

where

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

Measurement:

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.

Calculation:

Use the formula above and calculate the specific rotation. Compare the calculated value with the expected.

Examples:

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°

Recommended Instruments:
Polarimeter Polartronic M 100
Unipol L 1000

Micro tube,
100 mm long

or

Micro tube,
10 mm long

2. Refractometry

The refractive index of an essential oil is a unique number that designates how the oil responds 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.

Examples:

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

Recommended Instruments:

Laboratory Refractometer ATR-W2

3. Density measurement

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.

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