Robust consumer demand has put the cannabis industry on the fast track to sustainable profitability. But strict regulatory frameworks require careful monitoring and planning on the part of cannabis growers, manufacturers, and retailers. This helps guarantee quality control, although it does put the onus on cannabis entrepreneurs to stay compliant with ever-evolving rules.

These legal requirements create the boundaries under which cannabis laboratories must operate. An array of sophisticated and expensive equipment is needed to provide a deep and thorough analysis, where cannabis ingredient concentrations, chemical profiles, and contamination levels are measured accurately and precisely.

Cannabis Analysis is Mandatory

Few people in the industry will tell you that regulations, standards, and cannabis testing isn't necessary. In the U.S., testing mandates vary somewhat from state to state. Nevertheless, scientists working in cannabis laboratories will generally be expected to test cannabis products for the following contaminants:

- Pesticides
- Residual solvents
- Heavy metals
- Microbes, fungi, and mycotoxins

Advanced testing will also be required to determine these important characteristics:

- Potency
- Moisture levels
- Terpene content

Here's a closer look at what each type of testing entails, along with a description of the specific equipment laboratories need to make sure the job gets done right.

Pesticides

Commercial cannabis growers often use pesticides that could be dangerous to humans if consumed in excess. State requirements vary as to the number of pesticides that must be tested for. In a perfect world, pesticide contamination should be minimal or non-existent in cannabis products, but even if a grower isn't using pesticides and their neighbor does something as simple as spraying their yard, it's possible for crops to get contaminated.

Liquid chromatography-mass spectrometry (LCMS) can detect most commercially sold pesticides. However, gas chromatography-mass spectrometry (GCMS) is the only reliable method for detecting others. Highly sensitive LC-MS/MS equipment can detect up to 200 pesticides, or more than double the number labs must test for in the most stringent states. Some

pesticides don't ionize successfully in LCMS machinery, however, and it is these that require the use of a GCMS analyzer.

For the most precise and reliable results, LC-MS/MS and GCMS systems that include triple quadrupole mass spectrometers are recommended. A headspace autosampler makes an indispensable addition to a GCMS system as well since this device can perform residual solvent testing and also provide detailed terpene profiles.

Residual Solvents

Solvents like butane, ethanol, and propane are frequently used in the production of cannabis waxes and oils. High concentrations are usually needed to produce highly pure extracts, which could put users of such products at risk if solvent contamination levels are significant.

Gas chromatography (GC) is used in residual solvent testing. Solvents are evaporated from a cannabis sample, extracted and injected into a headspace autosampler, which is incorporated into superior-quality GCMS systems. If solvent concentrations are found to be excessive, the cannabis extracts tested will not be approved for sale or further processing.

Heavy Metals

Heavy metals like lead, arsenic, cadmium, and mercury can be absorbed from the soil by cannabis plants. Testing for heavy metals is mandatory because of their toxic effects, and products that contain more than minuscule trace amounts cannot be legally sold for processing or consumption.

To get precise readings of heavy metal content, labs will perform an evaluation known as inductively coupled mass spectrometry or ICP-MS. This process can detect different isotopes of the same element, allowing for a detailed analysis of heavy metal content. A high-quality ICP-MS system will include mass spectrometry hardware plus customized software that aids in the analysis.

Microbes, Fungi, and Mycotoxins

Not surprisingly, most states require cannabis labs to test for fungal or microbial contamination. Further testing is mandated to detect mycotoxins, which are toxic allergens produced by fungi.

A high-sensitivity LC-MS/MS system suitable for identifying pesticides should work just as well for mycotoxins. But fungi and microbe detection is more complicated and best carried out using equipment that performs polymerase chain reaction (PCR) testing. Precision measurements of bacteria, mold, yeast, and fungus contamination can be obtained through PCR testing, along with information about the characteristics of microbial DNA. Other methods are available for microbial and fungus testing, but PCR machines are known to produce the quickest results.

Potency

Cannabis contains many types of cannabinoids, all of which play some role in determining the nature and strength of its effects. However, most states only require testing for THC and CBD, which are the prime medicinal ingredients in medical-grade cannabis products.

Precise potency testing can be achieved through the process of high-performance liquid chromatography (HPLC). An HPLC analyzer will deliver a full-spectrum description of cannabinoid concentrations in any cannabis sample, unmasking the potential of that cannabis product to create desirable effects in consumers.

Moisture Levels

Optimum moisture levels for stored cannabis products are in the 5-12 percent range. Anything more and mold can form, turning health-restoring medicinal products into a threat to human health. Anything less and the cannabis may eventually crumble and disintegrate.

A moisture balance instrument can determine cannabis moisture levels. A sample of a particular cannabis extract is heated inside a chamber until all the moisture it contains is evaporated. The volume of the evaporation residue is then measured, and calculations are performed to determine what percentage of the sample was actually comprised of water.

Terpene Content

Terpenes are chemicals that help give cannabis plants their unique flavors and smells. More importantly, they work synergistically with cannabinoids to amplify or modify their effects. Knowledge about terpene content adds texture and depth to a cannabis product's chemical profile, revealing important information about their impact on the conditions they're being used to treat.

Testing for terpene makeup is not required in most states. But such tests provide valuable data nonetheless. Providing this information entails no extra expense for laboratories since a GCMS system used to test for pesticide and residual solvent contamination can also measure terpene concentrations (as long as it includes a headspace autosampler).

Safety is Profitable

Cannabis laboratories are expensive to equip. But the information obtained through broad-based testing is so valuable that the investment will pay for itself many times over in the long run. Consumers are kept safe by such testing, and that is a highly marketable benefit.