

## R&D in a week

Research and Development is often viewed as a very lengthy process, and this can be the case. Significant decisions may be made based on the outputs from R&D and so the information has to be right and scientifically valid – this takes time. There are however technologies and approaches that can be taken to deliver R&D in a modular approach, helping companies to build up their R&D portfolio and reduce risk involved in R&D.

In this article we will outline a range of equipment and techniques that can be used to deliver research information in short spaces of time, and potentially\*, within a week.

(\*terms and conditions apply!!)

### 1. High Performance Thin Layer Chromatography

HP-TLC can rapidly separate complex mixtures and identify and quantify the key compounds present. It can achieve similar results to LC-MS but in a much quicker and cheaper way. Examples of applications of HP-TLC are:

#### Authenticity of essential oils

Essential oils can be adulterated by the addition of cheaper oils. HP-TLC can provide a rapid and relatively cheap way to test for essential oil adulteration. A standard pure oil is applied to the HP-TLC stationary phase, along with the query sample. As the standard oil separates into its component parts it can be compared to the query oil. Quantification of each component can be achieved by measuring and comparing the images produced to a known concentration.



#### Screening for natural extract anti-microbial activity

Natural extracts can have a range of anti-microbial activity, and the identification of which compound in a mixture provides this activity can be of great use, and can often be essential. HP-TLC can be used to determine this. The extract of interest is applied to the stationary phase of the HP-TLC plate and separated along the plate. A solution containing the micro-organism of interest is then applied to the plate. The plate is incubated for a period of time and then observed for a zone of clearing. This zone of clearing is indicative of anti-microbial activity. The band that is at

the centre of this zone can then be identified through use of a known standard, or can be extracted and subjected to further analysis to determine its identity.

### Sugars in honey

The ratio and type of sugar in honey is important to determine its fructose-to-glucose ratio, for authentication and as a quality control parameter, and also as an indication of its tendency to crystallise. HP-TLC can be used as rapid way to determine fructose and glucose content (as well as other mono and disaccharides). As with most biological products, content can vary considerably during the course of the year and HP-TLC is an excellent choice to monitor this and provide valuable information to growers, producers and retail.



### THC compliant hemp

The growing of hemp in Ireland is a rapidly emerging agricultural industry. Hemp can be harvested and used for production of CBD oil, for protein and fibre production. It is also an excellent choice to support crop rotation. The difference between marijuana and hemp is the content of the psychoactive cannabinoid, THC (Tetrahydrocannabinol). Hemp cultivars used in Ireland must come from a defined, recognised source, and must be less than 0.2% THC. Adherence to regulations, and demonstration of this is key; HP-TLC is an excellent way to do this. Extracts from hemp can be applied to the HP-TLC stationary phase and separated into individual cannabinoids, including THC. Standards can be run alongside query samples and quantitation can be achieved using high tech densitometry and software.

### API cleaning compliance

Cleaning and demonstration of cleaning efficacy is crucial in the pharmaceutical industry. HP-TLC is an excellent choice for the pharmaceutical sector to implement a rapid, cost-effective and sensitive in-house method. Prior to implementing any new method, it must be validated and observed. The equipment and facilities at Shannon ABC (including our HP-TLC) are available for industry to 'try before you buy'. Methods for API (active pharmaceutical ingredient) detection and quantification can be developed on our HP-TLC system, and aligned with industry needs and individual requirements.



### Uniformity testing of Coenzyme Q10

Coenzyme Q10 can be used as a dietary supplement, and is a high value nutraceutical and cosmetic ingredient. Given its value, ensuring consistency of ingredient concentration and formulation efficiency can save companies considerable cost. HP-TLC can provide a rapid and cost effective way to compare numerous samples at the same time, providing essential data for companies to ensure efficient use of this expensive ingredient.

### Melamine in milk

The use of melamine in milk and milk products was proven to be a significant problem in 2008; it is a contaminant and adulterant that still requires monitoring. Multiple milk samples can be applied to the HP-TLC stationary phase and, using specific methods, determine melamine levels down to 20mg/L, some concentration of the sample may be required as the WHO recommends no greater than 0.1 mg/L in liquid milk.



### Aflatoxins in food

Aflatoxins are poisonous compounds that can be produced by certain species of fungi, predominantly on grain crops when stored in damp conditions. Monitoring for the presence of aflatoxins is therefore a priority for specific sections of the food sector. Due to the large volumes of grain that may be involved; rapid, reliable and cost effective methods that are capable of handling significant volumes of samples are of great use. Extracts can be made easily from grain samples and applied to the HP-TLC system. When run under specific conditions, and with aflatoxin controls, rapid approval of grain shipments can be achieved.

## 2. Inductively Coupled Plasma – Mass Spectroscopy

ICP-MS is an extremely sensitive way to measure heavy metals and minerals in a range of materials and is particularly applicable in the pharmaceutical and food industries. Prior to analysis, some materials (eg food matrices) must be treated first with microwave digestion, to prepare the sample for analysis.

Seaweed is a highly nutritious and bioactive bioresource. Knowledge of its metal and mineral content is important for two reasons. Firstly, the greater the mineral and trace metal content, the better in terms of its beneficial impact, and secondly, it provides a way to determine the heavy metal content of the seaweed, to ensure it is safe for consumption. Atomic absorption can be used to measure many of these end-points, however ICP-MS is a much more rapid method to measure a wide variety of chemicals.



There are a range of approved health and nutrition claims that companies can make about their food and drink products. These claims are contingent on the ingredients in their products, and the concentration that they are at. There are a range of health and nutrition claims that a company can make when mineral and trace metal concentrations are above certain levels. More information on this can be found on the European Food Safety Authority website

([www.efsa.europa.eu](http://www.efsa.europa.eu)). ICP-MS is a rapid and sensitive way to determine if there are scientifically validated and proven ways that your food or drink product is contributing to health and nutrition.

### 3. Fourier Transform Infrared Spectrophotometer

FTIR uses Infra-Red light to measure composition and attributes of a range of bio-resources. It does this by producing an infra-red spectrum of the sample of interest. The interpretation of this spectrum can then be used to produce information about the sample.

A new FTIR at Shannon ABC Operates in all three regions of Infra-Red spectrum: Near- Mid- and Far-IR, and also has an FT-Raman capabilities.

Each of these FTIR regions and the FT-Raman attachment have their own unique applications:

#### i. Near-IR

The Near-IR region is routinely used for analysis of complex samples such as quality checks of composts and substrates for cultivation of fruit, vegetables and mushrooms.



Near-IR analysis can also be used for quality check of biofuels used in the production of biogas in aerobic and anaerobic reactors, energy production in fluidised bed reactors and pyrolytic reactors.

#### ii. Mid-IR

Mid-Infrared Spectrum analysis are utilised in many industries including Pharmaceutical, biopharmaceutical, Forensic analysis, Chemical and Petrochemical and analysis of gases and gaseous contaminants.

Examples of Mid-FTIR analysis include:

#### Active pharmaceutical Ingredients in Pharma industry:

Mid-IR techniques are frequently used for the study of API purity and crystallinity; a fingerprint spectrum can be produced by FTIR which supports the quality control function in terms of consistency of product. The FTIR instrument is available in Shannon ABC for pharmaceutical companies to determine how this technology may help support their production processes.





### Trans fat analysis of foods

Trans-fats are unsaturated fats that, if present at too high a level in the diet, can cause an increase in risk for heart disease. FTIR can be used to monitor levels of Trans-fats in food products to help companies optimise their production processes.



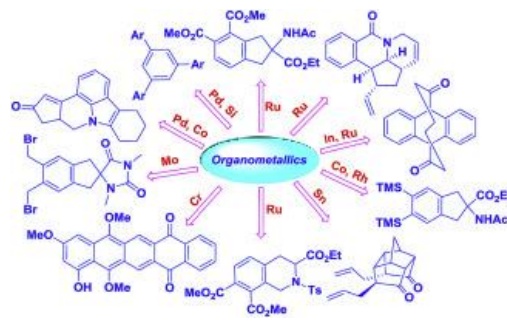
### Detection of harmful substances such as Phthalates

Phthalates are plasticisers that have been used for decades. More recently a number of these have been banned due to concerns about the health problems that they may cause. FTIR can be used to determine whether phthalates are present at levels considered relevant for health. Phthalates have a standard FTIR spectrum and products suspected to contain phthalates can be tested alongside controls to determine whether phthalates are present or not.

### iii. Far-IR

Far-IR is utilised primarily in material science and can be used in for the following applications:

Synthesis of various materials in chemical, petrochemical and Pharmaceutical industries as in this region, organic meets metal and the interactions between these two can be studied using Far-IR technique



### FT-Raman attachment

The FTIR Instrument now available in Shannon ABC has an FT-Raman attachment, this allows the study of all of the compounds described above in water or other aqueous solvent, which is not possible using FTIR on its own. This is very useful for identification of biological compounds with fingerprint accuracy

Another very useful opportunity, now available at Shannon ABC is to use our FTIR in Raman mode for the study of plastics and their composition, which are very useful in prediction of a plastics physical and mechanical properties as well as plastics degradation pattern.



## 4. Bomb Calorimeter

A bomb calorimeter is the recognised way to measure the calorific or energy potential of a material. It is used extensively in the food and biomass industries. A sample is burned under controlled conditions and the heat of combustion is calculated.

Consumers will be very familiar with seeing calorific value on food products, this value is measured using a calorimeter. We can help both food and animal feed companies with product development based on calorific requirement of their product.

The energy potential of fuel oils is required for a range of industries and applications, including construction, aviation and road transport.

Alternatives to fuel oils also require this crucial information. The bioeconomy is based on better use of biomass and bio resources; this use can often be as a fuel source. In these circumstances, it is vital to know its energy potential.

## 5. Freeze Dryer/Spray Dryer

Both freeze dryers and spray dryers ultimately do the same thing; they remove water from a solution, leaving behind a dry powder. This may be necessary to concentrate a sample, as a formulation requirement, or to make the product more transportable. Freeze drying can be more energy intensive than spray drying, and spray drying can also be used to encapsulate a range of compounds within the spray dried material.

We can use our lab scale drying facilities to help companies identify conditions that may be suitable to scale up their production process, or to determine how appropriate either of these methods is for their product.

## Contact us to learn more

R&D is well recognised as being essential for businesses to grow, however engaging in R&D can often be considered as being a substantial investment over years at a time. This can sometimes provide a roadblock for companies to engage in R&D. There are a range of ways that companies can get involved with research, over shorter periods of time, to answer specific questions and provide a platform to later expand their R&D capabilities. Please contact us if you want to learn more about 'R&D in a week' (!), or have any research questions that we may be able to help you with.

**[www.shannonabc.ie](http://www.shannonabc.ie)**