How Is Analytic Chemistry Used In The Medical Industry?

Introduction

Analytical chemistry considers and employs a variety of equipment and methods in order to separate, identify and quantify matter. After the first flame tests in 1860, the importance of qualitative and quantitative analysis has been identified and major advancements have been made with many of the spectroscopic and spectrometric methods only being refined in the late 20th century. One of these methods includes the analytical technique ‘mass spectrometry’. Mass spectrometry assesses the mass-to-charge ratio of ions. Since mass spectrometry has been developed it has had many applications including beneficial and unexpected consequences especially in the medical industry. (Wikipedia, 2020)

Mass Spectrometry

In order to identify the characteristics of molecules, a mass spectrometer needs to convert the sample into ions in order to be manipulated by external magnetic and electrical fields. There are three essential functions of a mass spectrometer. (Michigan State University, 2013)

These includes the:

- Ion source which is a small ionised sample (generally, a sample of cations)
- Mass analyser which sorts and separates ions according to their mass and charge
- Detector which takes measurements and relays the results to form a chart.

There are many methods used to achieve the three steps listed above. The most common procedure to ionise a sample occurs by passing a high energy beam of electrons through the sample. By accelerating and focusing the beam on the ions, the ions will separate which allow them to be bent by an external magnetic field. This information will then be detected electronically which is analysed by a computer. (Michigan State University, 2013)

The data received by the detector and analysed by the computer produces a mass spectrum. Each peak on the graph represents a ions having a specific mass-to-ion-ratio. The height of the peak shows the relative abundance of each ion, with the most abundant ion being assigned an abundance of 100. (Michigan State University, 2013)

Beneficial Consequences in Medicine

The uses of mass spectroscopy has had a large amount of beneficial consequences ranging from isotope dating to space exploration however this scientific development interacts more with humans through the medical applications that is has. Often, these developments have benefits but also have unexpected consequences.

Through extracting a mass spectrum from a virus’ protein shell, a group at the Carnegie Mellow University was able to identify the unknown virus after it was analysed by a mass spectrometer.

This analyses also allowed the team to, unexpectedly, gain greater accuracy in improving the mass spectrum of a ‘von Willebrand’ factor which is essential for blood coagulation. Through mass spectroscopy and following a similar method, the medical industry took the first steps in identifying important biological molecules such as virus’ and clotting factors by simply analysing fragments of the molecule. (Carnegie Mellon University, 2017)

In a similar study lead by Silvia Balbo and Romel Dator, they explored how mass spectrometry can be used to evaluate chemical exposure from e-cigarettes which creates vapours from liquids containing nicotine. The team analysed the saliva of a group of users before and after a vaping session lasting 15 minutes. The team centred their research around carbonyl compounds, propylene glycol and glycerol. The study found that the users had 50 times the amount of acrolein and methylglyoxal as well as increased levels of in their saliva. These compounds are toxic and may act as a DNA adduct which is a segment of DNA which will eventually cause cancer. (Balbo, S & Dator, R, 2018).

Bibliography

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