Top-Down Analytics

Metabolomics 2018

Charged with Massive Potential

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I. Introduction

A. Report Objectives

- Characterize the demand for metabolomics systems and consumables, segmented by the following:
    - Instrumentation technology/product
    - Application type
    - Region
    - Lab industry/sector
- Perform an end-user survey of metabolomics laboratories to determine current usage patterns, needs, and expectations
- Identify and describe the factors providing opportunities and challenges that will affect growth of the overall market as well as relevant segments
- Identify the leading manufacturers and products, and their impact on the market
- Provide a timeline of developments in the market, including regulatory developments, product launches, partnerships, and mergers and acquisitions
- Forecast the growth of the metabolomics market and its segments through 2022

B. Methodology

In producing this report, TDA used a mixture of both primary and secondary research methodologies. Primary research is a key component in TDA's information collecting activities that involves interactions with knowledgeable sources, including end-users, individuals within regulatory agencies, as well as instrument company executives, marketing and technical personnel, and other informed observers. TDA also attends international tradeshows and exhibitions on a regular basis to keep up to date with industry trends and emerging technologies/applications.

Trends and opportunities discussed in this report are a result of thorough analysis of data from interviews with key industry figures and end-users, as well as the consultation of secondary sources such as periodicals, research reports, and white papers.

C. Sources of Information

1. Primary Sources

TDA interviewed both instrument manufacturers and metabolomics end-users. The end-user survey of labs was primarily carried out using web-based surveys of qualified respondents, along with some phone conversations.

2. Secondary Sources

Secondary research was conducted to provide a backdrop of this growing market, and to gain a better understanding of the companies and products. It is used to corroborate market estimates and supplement insights drawn from TDA's primary research efforts. Sources of information included reports from state and federal governments, reports analyzing the instrumentation market, news publications, and annual reports from related companies.

D. Market Size and Forecast Estimates

In developing market size and growth estimates for this report, TDA leveraged its knowledge of the lab instrumentation market. The **top-down approach** involves defining the global market for lab instrumentation and applying various ratios and filters that continually reduces the figure to an estimation of the net market. TDA has defined the overall lab and process analytical instruments market, which accounted for roughly $55 billion in 2017, based on the analysis of 1,000+ instrument companies. TDA validates data primarily through interviewing suppliers and other experts in the field, analyzing financial data, and poring over publically available information.

TDA also performed a **bottom-up analysis** by identifying the customer segments for analytical instrumentation, specifically for metabolomics. While there may be many areas for error due to the nature of our assumptions made during the research of this report, we believe the triangulation of data from varied resources increases our level of confidence, and that the estimates presented in subsequent chapters are an accurate representation of the market opportunity.

E. Market Scope

1. Technology Overview

The workhorses of metabolomics include a range of configurations of GC-MS, LC-MS, and NMR. There are other types of instruments that are used including IR and other label free systems. This report will focus mainly on the primary technologies within chromatography, mass spectrometry, and NMR.

The following descriptions of the technologies are not meant to be exhaustive, but instead to provide a reader with a general understanding of the techniques. Please refer to online resources or scientific textbooks that are focused on these technologies for more detailed information about them.

a) Chromatography

Chromatography is a laboratory technique used to separate a mixture into its components. In a typical liquid chromatography (LC) experiment, a mixture is passed through a tube filled with silica beads (column). High pressures (up to 1000+ bar) pumps are used to move the liquid mixture (mobile phase) through the column. Separation occurs because the components of the mixture will generally move through the silica bead matrix (stationary phase) at varying rates depending on chemical/ physical properties. UV/Vis detectors are used to identify the components.

Similar separation principles are applied to gas chromatography (GC), but the mobile phase is a gas and the column is much longer. In GC, the mixture is dissolved in a solvent and heated to change the liquid to gas. A carrier gas is used to push the vaporized sample through a packed column. Capillary columns are typically used for complex mixtures as they will provide higher resolution.

Key technologies: High Performance Liquid Chromatography (HPLC), Ultra-HPLC (UHPLC), Gas Chromatography (GC)

b) Mass spectrometry

Mass spectrometry (MS) is an analytical technique that separates ions based on their mass-to-charge (m/z) ratio. The ion source in the mass spectrometer converts a chemical compound into ions by bombarding the sample with electrons. The ions are then accelerated through an electric and/or magnetic field causing separation of light and heavy ions. The detector captures the spectrum of ions and displays the relative abundance of detected ions as a function of the mass-to-charge ratio. The atoms or molecules in the sample are then identified by correlating known masses to the identified masses or fragmentation pattern in a database.

Key Technologies: Triple Quadrupole LC/MS, Quadrupole-Time-of-Flight LC/MS, Orbitrap, GC/MS

c) Nuclear Magnetic Resonance Spectroscopy

NMR spectroscopy is another technique for determining the molecular structure of a compound, or a mixture of compounds. The systems use a magnetic field to excite the nuclei in the sample, which generates a change that is detected using sensitive radio receivers that surround the sample. The change reflects aspects of the given nucleus's environment, and can be associated with functional groups and other unique characteristics in order to identify the compound. The most common types of NMR are proton and carbon-13 NMR spectroscopy, which in essence analyze the environments of the hydrogen and carbon atoms, respectively.

2. Application Sectors and Industries

a) Academia/ Medical Centers; Government

The large majority of metabolomics research is currently carried out in universities or associated health sciences and research centers. The market is diverse, but is largely focused on applications to human health, as well as agriculture and food. There is a large range of labs, from small to large. There are several major metabolomics labs that have received considerably large grants from the government; however, the bulk of metabolomics labs are either smaller components of research groups or shared/core facilities with varying degrees of services provided to other labs.

b) Contract Research Organizations

CROs are another significant component of the market. These companies have traditionally provided bioanalytical services to pharmaceutical companies for their clinical trials; some of this activity has reportedly been moved back into internal pharma labs. The emergence of metabolomics as its own area has prompted these companies to offer additional research services. In addition, several new companies have been formed to pursue diagnostics based on metabolomics; however, these take a long time to develop, and the companies are offering specialized metabolomics services in the meantime.