

Metabolomics 2018

Charged with Massive Potential

March 2018

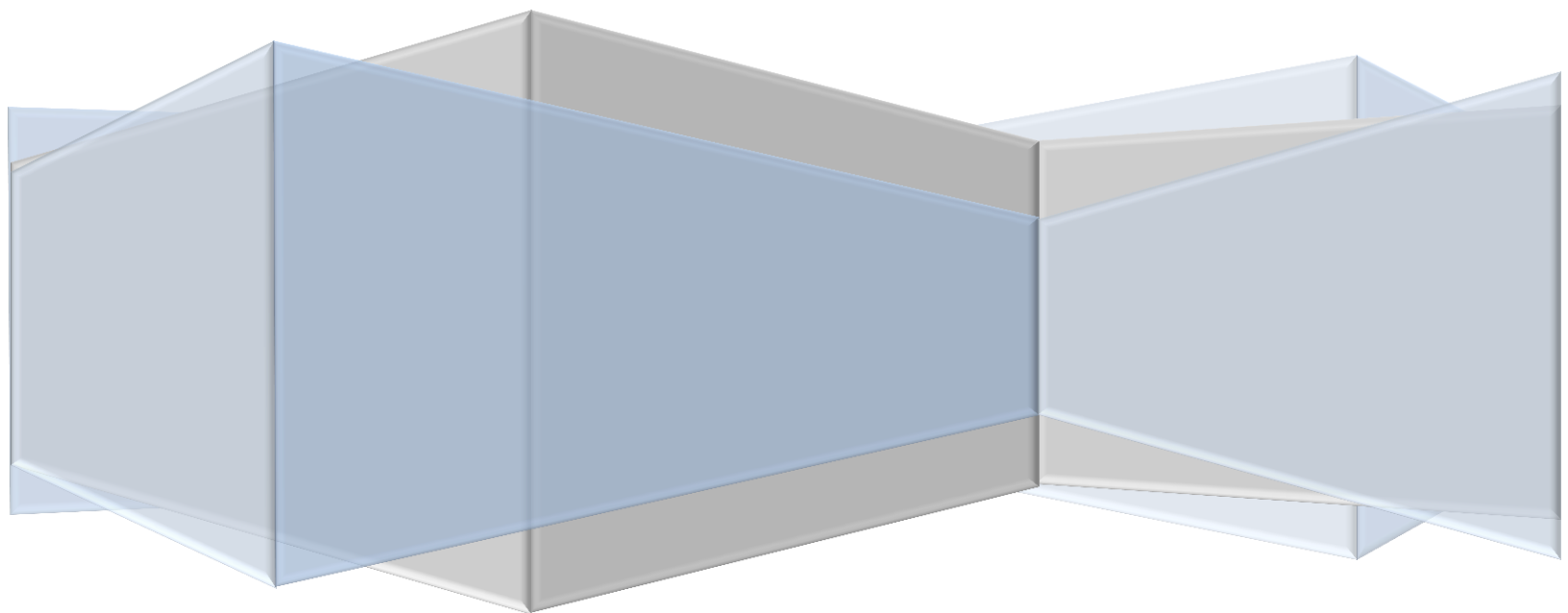


Table of Contents

I. Introduction	1
A. Report Objectives	1
B. Methodology	1
C. Sources of Information	2
1. Primary Sources	2
2. Secondary Sources	2
D. Market Size and Forecast Estimates	2
E. Market Scope	3
1. Technology Overview	3
2. Application Sectors and Industries	4
II. Executive Summary	6
III. Metabolomics Benchmarks	8
A. NIH Metabolomics Grants from 2000–2017	8
B. A Count of NCBI Publications with “Metabolomics”	8
C. Targeted, Untargeted, Profiling, Fingerprinting, Footprinting	9
D. Number of Metabolomics Labs	10
E. Installed-base of Instruments	11
IV. End-User Survey	12
A. Demographics	12
1. Regional Distribution	12
2. Industrial Sector Distribution	12
3. Laboratory Function	13
4. Metabolomics Experience Level	14
5. Laboratory Size	15
B. Technology Usage	15



1.	Technology Type for Metabolomics.....	15
2.	Technology Manufacturers	16
C.	Untargeted vs Targeted Metabolomics	21
D.	Molecule Types and Analytes	23
1.	Overall Molecule Types.....	23
2.	Molecule Type Trends.....	24
3.	Analytes Identified per Sample	24
E.	Metabolomics Research Focus	24
1.	Overall Research Focus	24
2.	Research Area Trends	25
3.	Outsourcing Sample Analysis	26
F.	Vendor Usage.....	27
1.	Sample prep and other consumables	27
2.	Top-Two Column Details	29
G.	Future Plans and Troubleshooting.....	32
1.	Future Purchase Plans.....	32
2.	Importance Criteria	32
3.	Troubleshooting Resources.....	33
H.	Trends	33
1.	Significant Trends.....	34
2.	Areas to be Changed or Improved	37
3.	Bottlenecks.....	40
V.	Market Demand.....	42
A.	Overall.....	42
B.	Demand by Technology Type.....	43
C.	Demand by Application Focus	45
D.	Demand by Region.....	46

E. Demand by Industry Segment	47
VI. Competitive Landscape	48
A. Collaborations, Initiatives, Other Deals	49
B. Current Products on the Market.....	70
C. Product Introductions	74
VII. Strategic Perspectives	79
A. Market Drivers	79
1. Abundance of Consortia, Collaborations	79
2. Some Promise in Clinical Applications	80
3. Lipidomics Picking up Steam	81
B. Market Restraints	82
1. Coverage Limitations Slow End-Users' Progress.....	82
2. Weak Momentum in Development of Clinical Tests	82
C. Challenges	83
1. Low Success Rate of Unknown Metabolite Identification	83
2. NMR Still Common, But Facing Certain Challenges	83
D. Opportunities.....	83
1. Sample Preparation Becoming High Priority.....	83
2. Standards and Reproducibility Needed	84
3. User-Friendly Software Tools Key to Growth.....	85
VIII. Corporate Profiles	86
A. Agilent Technologies.....	86
1. History	87
2. Notable Collaborations	87
B. Bruker Corporation	88
1. History	89

2. Notable Collaborations	89
C. Danaher Corporation	89
1. History	90
2. Notable Collaborations	90
D. Shimadzu Corporation	91
1. History	92
2. Notable Collaborations	92
E. Thermo Fisher Scientific.....	92
1. History	93
2. Notable Collaborations	94
F. Waters Corporation	94
1. History	95
2. Notable Collaborations	95



List of Tables

Table III-1: Installed base of Instruments for Metabolomics.....	11
Table IV-1: Regional Distribution	12
Table IV-2: Industrial Distribution.....	12
Table IV-3: Metabolomics Experience Level	14
Table IV-4: Lab Size	15
Table IV-5: Instruments per Lab – TQ LC/MS.....	16
Table IV-6: Instruments per Lab – Q-TOF LC/MS.....	17
Table IV-7: Instruments per Lab – GC/MS	18
Table IV-8: Instruments per Lab – Direct Inject MS.....	18
Table IV-9: Instruments per Lab – NMR.....	19
Table IV-10: Instruments per Lab – FT-ICR	20
Table IV-11: Metabolomics Application.....	21
Table V-1: Overall Metabolomics Demand by Technology, 2017–2022 (\$Millions)	42
Table V-2: Overall Metabolomics Demand by Technology Type, 2017–2022 (\$Millions)	43
Table V-3: Metabolomics Demand by Application Focus, 2017–2022 (\$Millions).....	45
Table V-4: Metabolomics Demand by Region, 2017–2022 (\$Millions)	46
Table V-5: Metabolomics Demand by Industry, 2017–2022 (\$Millions).....	47

List of Figures

Figure III-1: NIH Metabolomics Grants from 2000–2017	8
Figure III-2: NCBI Metabolomics Articles from 2000–2017	9
Figure IV-1: Regional Distribution	12
Figure IV-2: Industrial Distribution	13
Figure IV-3: Laboratory Function	13
Figure IV-4: Metabolomics Experience Level.....	14
Figure IV-5: Lab Size	15
Figure IV-6: Instruments Used for Metabolomics	16
Figure IV-7: TQ LC/MS Manufacturers.....	17
Figure IV-8: Q-TOF LC/MS Manufacturers	17
Figure IV-9: GC/MS Manufacturers	18
Figure IV-10: Direct Inject MS Manufacturers	19
Figure IV-11: NMR Manufacturers.....	19
Figure IV-12: ICP-MS Manufacturers	20
Figure IV-13: FT-ICR Manufacturers.....	20
Figure IV-14: Untargeted vs Targeted Metabolomics Applications	21
Figure IV-15: Metabolomics Application by Region	22
Figure IV-16: Metabolomics Application by Industry	22
Figure IV-17: Metabolomics Application by Lab Size.....	23
Figure IV-18: Molecule Types being Analyzed	23
Figure IV-19: Metabolomics Research Focus.....	25
Figure IV-20: Metabolomics Research Focus.....	26
Figure IV-21: Samples Outsourced by Region.....	26
Figure IV-22: Samples Outsourced by Industry	27
Figure IV-23: Chief Suppliers of Sample Prep Kits	28
Figure IV-24: Chief Suppliers of LC Columns.....	28
Figure IV-25: Chief Suppliers of GC Columns	29
Figure IV-26: Chief Suppliers of Analytical Reference Standards	29

Figure IV-27: Primary Column Vendor	30
Figure IV-28: Secondary Column Vendors	30
Figure IV-29: Most Popular LC Columns based on Particle Size	31
Figure IV-30: Most Popular LC Columns based on Porosity	31
Figure IV-31: Future Purchase Plans	32
Figure IV-32: Importance Criteria for New Instrument Purchase	33
Figure IV-33: Troubleshooting Resources Used.....	33
Figure V-1: 2017 Overall Metabolomics Demand by Technology	43
Figure V-2: 2017 Metabolomics Demand by Technology Type	44
Figure V-3: 2017 Metabolomics Demand by Application Focus.....	45
Figure V-4: 2017 Metabolomics Demand by Region	46
Figure V-5: 2017 Metabolomics Demand by Industry	47
Figure VI-1: 2017 Metabolomics Vendor Share.....	48

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.

