Mass Spectrometry-based Multi-Omics: Combinations of Proteomics, Metabolomics, and/or Lipidomics

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Abstract

Studies that integrate unbiased measurements across at least two omics layers are often referred to as “multiomics”. Measurable “omes” include the genome, transcriptome, proteome, and metabolome. Any combination of omic measures can be referred to as multiomics; for the scope of this review we focus on research combining proteomics and metabolomics. Mass spectrometry is the leading technique for analysis of the proteome and the metabolome. Due to improvements in sample preparation and data collection, more studies are incorporating both mass spectrometry-based proteomics and metabolomics. In this review, we discuss the perceived value of multiomics, advances in sample preparation and data collection, the current state of multiomic data integration, and clinical examples of multiomic analysis. Finally, we explore major barriers preventing democratization of mass spectrometry based multiomics to the same level as nucleic acid analysis, and we suggest solutions to break these barriers.

Introduction

Topics:

1. importance of omic measurement: Molecular profiles in biological systesms lead to macroscale phenotypes.

2. concept of multiomics

3. What is proteomics

4. what is metabolomics

    - polar metabolomics
    - lipidomics

5. what does multi-omic integration mean?

6. Other reviews

    Multiomic studies in mitochondria [1]

    - discussion of how to prepare samples, QC, and methods to analyze the samples by MS
    - includes mention of linking to functional (phenotype) readout

    Multi-omics approaches to disease [2]

    - overview of each omic technology
    - first section is discusses considerations for before multiomic studies: consider the exact disease, sample size, human samples versus model organisms, plan for analysis strategy before collecting data
    - second section is focus on methods for omic integration:
    - third is future directions:

List of Planned Figures: 1. overview of how omic layers are related showing different ‘flavors’ of each omic analysis * genomics * transcriptomics * proteomics * metabolomics * microbiomics

3.

Sample Preparation for Multi-Omic Analysis

Integrative multi-omics analysis is a powerful approach to study complex biological responses and has gained popularity in recent years. To avoid the potential

1, Sample preparation for proteomics

2, Sample preparation for metabolomics

2.1 non-targeted metabolomics

[3]

2.2 targeted metabolomics

2.3 lipidomics

[4]

3, Integrative sample prepatation for multi-omics

In the context of multi-omics analyses, being able to perform multiple measurements on the same sample can also decrease experimental variation.

[5]

[6]

[7]

SIMPLEX: [8]

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