Chapter 1

Nutriproteomics: An Advance Methodology of Nutrichemical Analysis

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ABSTRACT

Deciphering the molecular interplay between food and health requires holistic approaches because nutritional improvement of certain health aspect must not be compromised by deterioration of others. Proteomics plays an important role as it expresses itself as a response to diet. Proteomics is a central platform in elucidating these molecular events in nutrition: it can identify and quantify bioactive proteins and peptides and address questions of nutritional bio-efficacy. Analysis of proteomics by highly specific, sensitive, and accurate MS has been made possible with MALDI or electrospay ionization of proteins and large peptides. Currently, the most commonly used proteomics technology involves either specific digestion of proteins (the bottom-up approach) or direct analysis of intact proteins after their chromatographic separation (the top-down approach) proteomics. Recently system biology has integrated computational modeling and experimental biology to predict and characterize the dynamic properties of proteins in biology could be a highly successful approach to human health.

INTRODUCTION

Food is a nutritive substance or a kind of fuel taken by an organism for their growth, repairing the system and maintaining life processes. Components of foods cooperate with our body at several levels, such as cellular, organ and molecular levels. Dietary components appear in complex mixtures, in which the concentration of the single compound and the interaction of several compounds conclude constituent

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bioavailability and bioefficacy. Advance nutritional and health study focuses on promoting health, delaying or preventing the onset of disease. The molecular relationship between food and health requires holistic approaches because nutritional enhancement of certain health aspects cannot be compromised by worsening of others (Kussmann, & Affolter, 2009). The study of food compositions, by the nutritional perspective, there are six different components of a balanced diet carbohydrate, protein, fats, vitamins, minerals, and water. Proteins are highly complex macromolecules, consisting of one or more long chain of amino acids. There are several proteins in the human body with diverse physiological functions including catalyzing a metabolic reaction, responding to stimuli, transporting molecules and DNA replication. The daily requirement of protein for adults is one gram per kilogram of the body weight. When the body is building new tissue, more proteins are required, so growing children and pregnant lady need more proteins.

Amino acids are building block or monomer of proteins and composed of an amino group, carboxyl group, a hydrogen atom and a distinctive side chain, all bonded to the α-carbon. Amino acids that cannot synthesize by an organism and thus must be supplied from the diet are known as essential amino acids. Nine amino acids that the human body cannot synthesize are phenylalanine, valine, threonine, isoleucine, leucine, tryptophan, lysine, methionine and histidine. Five amino acids alanine, asparagines, aspartic acid, serine, and glutamate, can synthesize in the human body and hence they are nonessential amino acids. Other six amino acids are considered as conditionally essential for human body, meaning their synthesis can be limited under the special physiological condition, these are glycine, alanine, serine, arginine, aspartic acid, and glutamic acid. There are several dietary proteins found in different food materials that have different composition of amino acids that fulfill the complete nutritional requirement for growth and development for example finger millet is reached in several essential amino acids like lysine and methionine that are important in the human health, growth, and development but remain absent from most of the other plants foods. Hence identification of amino acid composition by nutriproteomics approach is essential. Nutriproteomics has emerged as a tool in nutrition research. It is a potent technology that consists of profiles and characteristics of dietary and body fluid proteins; absorption, digestion, and metabolism of nutrients as well as their role in growth, health and reproduction (Wang, Li, Dangott, & Wu, 2006).

The interplay between the nutrition and health has been well-known for centuries: a Greek doctor Hippocrates can be seen as the father of “functional food,” because he suggested using food as the medicine and vice versa another example of this kind of long-term experience is the record of traditional Chinese medicine, a famous doctor Sun Si- Miao, stated that “When a person is sick, the doctor should first regulate the patient’s diet and lifestyle”. The latest era of nutritional research transforms this rather empirical information to evidence-based molecular science, because food ingredient interacts with our body systems such as cellular, organ, and molecular levels. Advance nutritional and health research centered on promoting the health, preventing or delaying the onset of disease, and optimizing other performance.

Proteomics is the large-scale study of the complete set of proteins and analysis of their expression, structure, and function (Kussmann, & Affolter, 2009). Proteomics holds immense promises for discoveries in nutrition research together with profiles and characteristics of proteins such as absorption, digestion, and metabolism. Proteome can be considered as a coupler between transcriptome of an organism and the ultimate responsive metabolome. The most usually used technique for proteomics is two-dimensional gel electrophoresis to separate the complex protein mixture. Mass spectrometry, matrix-assisted laser desorption ionization or electrospray ionization serves as a more specialized protein identification tool for different proteins. Though there are very fewer reports of protein profiling for characterizing nutritive proteins (Kumar, Metwal, Kaur, Gupta, Puranik, Singh, & Yadav, 2016; Kussmann, & Affolter, 2009;
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