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Editorial

Foodomics; Principles, Challenges, and Applications - A Promising Tool for Food Analysis

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Human nutrition is a multifaceted, complex, and broad scientific field, demonstrating how food components, ingredients and flavors present required nourishment for the life-sustaining [34]. Since the dawn of civilization, food and nutrition components have been obligated to maintain human life by releasing energy [11]. However, over the decades, human nutrition has been widely considered as a promising resource to treat and/or prevent diseases [21]. Recently, the application of modern research in nutrition and food science has been shifted from classical technologies and equipment to advance analytical methodologies [4]. To achieve the mentioned goal, a new discipline, namely called foodomics, was introduced as the global strategy through using the application of advanced omics in the food science domain [17].

The history of using foodomics dates back to 2009 when this term was introduced by Cifuentes in the first international conference at Cesena, Italy [2]. Foodomics is an analytical and interdisciplinary strategy that offers a comprehensive vision into the food and nutrition area [2,8]. Foodomics domain focuses on the food ingredient using qualitative and quantitative data [4,8]. Additionally, foodomics can help researcher to identify the specific effects of foods on human body, health and diet [1,5]. In foodomics, understating the interaction of food with human's body using genetic, protein, and metabolic profiles can be one of the most important achievement [6,35]. Additionally, applying foodomics can assist researchers to identify the effects of allergens and food-borne pathogens, thus control the negative impacts of ingredient on health [11].

Generally, foodomics includes 5 main subsets: epigenomics, genomics, transcriptomics, proteomics, and metabolomics [18]. In the epigenomics domain, the expression of gene (s) are analyzed through evaluating the effect of foods on the modifications and changes in the genetic pathways and histone activities of human's cell [33]. Epigenomics domain of foodomics can also interpret DNA -methylation, -phosphorylation, -acetylation as well as histone tails methylation of humans' cell [22,36]. Furthermore, the regulation of miRNAs expression by food in different diseases pathways, like cancer cells, have been identified as an advance achievement of epigenomics in foodomics. Epigenomics shows how some nutrients such as choline, vitamin C, and omega-3 fatty acids control the expression and activity of miRNAs in apoptosis and metastasis through changes in the DNA- methylation [20,22]. In the genomics domain, researchers examine all genetic profiles and the details of genome like structure, function, etc. The application of genomics in the nutrition investigation is a broad topic with focusing on the relationship between hereditary, genes and the nutritional pattern is the matter of concern [19]. Furthermore, genetic disorders that can be controlled and/or treated with proper nutrition, such as type 1 diabetes, are the most interesting topics in the genomics [10]. Transcriptomics in foodomics technology focuses on the various aspects of food's effect on the RNA transcription inside the human's cells [16]. Additionally, using transcriptomics can help scholars to evaluate the influence of hazardous substances, toxic food components as well as healthy food on the transcription process [23]. On the other hand, transcriptomics shows how nutritional substances can alter gene transcription and expression [24]. In the proteomics area of foodomics, researchers examine protein profiles qualitatively and quantitatively [10]. Likewise, proteomics can identify the food effect on the translation rate of proteins, their post-translation changes, and the enzyme activity [25]. In the metabolomics domain, the function of food, the activity of secondary metabolites, and their interaction with the metabolic pathways of human's cells are discussed [12]. For example, by examining the metabolic profile of urine through metabolomics in foodomics domain, it is possible to understand the changes in the metabolic pathways of cells in different tissues of the body due to a specific diet [26].

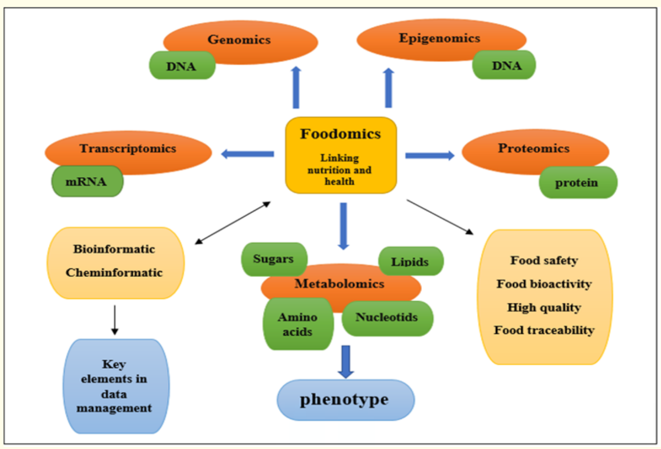

Figure 1

Epigenomics, genomics, transcriptomics, proteomics, and metabolomics are parts of foodomics that researchers with using from bioinformatics and cheminformatics databases can study these techniques. Metabolic profiles, which include all lipids, amino acids, nucleotides, and sugars, creates the phenotypes [8]. Creating a link between nutrition and health through foodomics, promotes food safety, food bioactivity, food quality and food traceability [5].

In foodomics, there are many analytical techniques that use in food analysis including (i) biological techniques (such as polymerase chain reaction (PCR)), (ii) spectroscopic techniques (such as mass spectrometry (MS)), (iii) separation techniques (such as high performance liquid chromatography (HPLC)), (iv) electrochemical techniques, (v) sample preparation techniques (such as purge and trap (PAT)), and (vi) hyphenated techniques [5]. The efficiency of genomics in foodomics aspect is highly dependent on the microorganism types and products [15]. For example, PCR can identify DNAs and RNAs of pathogens in food and detect unwanted components in food and food allergens [30]. Electrochemical is new technique in food analysis that can increase the speed and accuracy of analysis [5]. Compared to other methods, applying electrochemical biosensors can help to overcome on the limitations such as low speed, high cost, large size of systems and sample preparation. Electrochemical biosensors can demonstrate the changes in food quality due to contaminants or pathogens by altering signals [29]. Reportedly, sample preparation, separation, and spectroscopic techniques are the main phases of foodomics [5]. In sample preparation techniques, a small amount of food can be prepared for more complicated arrays of analysis [13]. This technique has advantages like increasing selectivity, saving time, reducing environmental damages, reducing the costs, etc. For instance, to have a better proteomics study, a high-yield protein and peptide substances should be prepared from the smaller amount of food for further analysis [13]. Additionally, to have a high- efficacy purge and trap method, the high-concentration and enrich volatile organic compounds should be separated [11]. In separation technique, the sample is divided into two or more components that at least in one of these components the target matter is enriched. HPLC is one of the separation methods that is used for both qualitative and quantitative analysis of raw materials and products. This method can be applied for the most food ingredients such as carbohydrates, phospholipids and amino acids [28]. Spectroscopic techniques should be applied based on interactions between light and matter and give us information about the structure of matter, qualitative and quantitative analyses [7]. Mass spectrometry has a wide range of applications in the analysis of water and food toxins, food contaminants and proteins in food [5]. This technique is also used to analyze genetically modified food products and gives an overview about the presence or absence of a specific compound, their chemical structure and amount in food [5]. Hyphenated technique is a combination of separation and spectroscopic techniques that allows the desired food to be well separated and purified by the separation and chromatography, and immediately identified and analyzed by the spectroscopic techniques [31].

As mentioned, foodomics play an important role in improving food quality, understanding the food's effect on chemical pathways in the body, detecting and controlling of foodborne illness, studying of genetically engineered product's effects and studying of agricultural research [5,9]. Foodborne illnesses are usually caused by improper storage and transportation of food [5] Although many foodborne illnesses have been controlled by different foodomics strategies, lots of foodborne illness have not yet controlled around the world [32]. For example, "listeriosis", which is caused by "Listeria monocytogenes", is transmitted through contaminated meat and dairy products. It is expected that in the near future, foodomics strategies can help to control and prevent foodborne illness [27]. Over the years, by developing the industries sectors, the levels of food's toxins have been significantly increased [5]. The development of industry leads to the widespread distribution of food worldwide, which in turn transmits food toxins to most parts of the world [27]. Therefore, Fodomics analysis techniques must be developed to be able to qualitatively examine food in the shortest time and with the greatest accuracy to determine the presence of food toxins [2,5].

Despite the mentioned advantages of foodomics, a few bottlenecks have been addressed during the application of this omics. It has been reported that the application of analytical techniques in foodomics are costly, time-consuming, and somewhat new [5]. Analyser systems require large space, specialized equipment and specialized technicians which are expected to be resolved in the future. The techniques used in foodomics should be more green and environmentally friendly [14]. Many of these problems and limitations have been addressed in electrochemical biosensors [29].

All the mentioned aspects suggest that by proper use of foodomics researchers are able to make an accurate bridge between diet, environment, and human's genetics [11]. This structural health bridge can also prevent many diseases through a proper nutritional diet, which can be achieved through the analysis of genetic, protein and metabolic profiles of the patient through omics strategies and with the help of bioinformatics database [3,11]. Because there are so many different chemical compounds in a meal that can have a positive and negative effect on each other, food safety, cell function, and molecular tests cannot provide integrated results separately. Therefore, the use of foodomics in achieving these comprehensive results is important [6]. Although foodomics has made significant advances in food analysis, this omics strategy needs a lot of progress and promotion in the future [3].

Bibliography

1. Zheng Chuangmu and Ailiang Chen. "System biological research on food quality for personalised nutrition and health using foodomics techniques: A review". *Journal of Food and Nutrition Research* 2.9 (2014): 608-616.
2. Cifuentes Alejandro. "Food analysis and foodomics". Elsevier 7109.43 (2009): 12-16.
3. Cifuentes Alejandro, ed. "Foodomics: Advanced mass spectrometry in modern food science and nutrition". *John Wiley and Sons* (2013): 52.
4. Capozzi Francesco and Alessandra Bordoni. "Foodomics: a new comprehensive approach to food and nutrition". *Genes and Nutrition* 8.1 (2013): 1-4.
5. García-Cañas Virginia., *et al*. "Present and future challenges in food analysis: foodomics". *ACS Publications* 84.23 (2012): 10150-10159.
6. Ibáñez Clara., *et al*. "Global Foodomics strategy to investigate the health benefits of dietary constituents". *Journal of Chromatography A* 1248 (2012): 139-153.
7. Berlin, Andrew, Christopher Gerth, and Tae-Woong Koo. "Spectroscopic analysis system and method". U.S. Patent Application.
8. Hasin, Yehudit, Marcus Seldin, and Aldons Lusis. "Multi-omics approaches to disease". *Genome Biology* 18.1 (2017): 1-15.
9. Botcherby, Lewis. "The Rising Role of Foodomics". *LCGC Europe* 148-153.3 (2019): 32.
10. Cho William CS. "Proteomics technologies and challenges". *Genomics, Proteomics and Bioinformatics* 5.2 (2007): 77-85.

11. Andjelković Uroš., *et al*. “Foodomics and food safety: Where we are”. *Food Technology and Biotechnology* 55.3 (2017): 290-307.

12. Idle Jeffrey R and Frank J Gonzalez. “Metabolomics”. *Cell Metabolism* 6.5 (2007): 348-351.

13. Abeel Scott M., *et al*. “Trends in purge and trap”. *Journal of Chromatographic Science* 32.8 (1994): 328-338.

14. Khakimov Bekzod and Søren Balling Engelsen. “Resveratrol in the foodomics era: 1: 25,000”. *Annals of the New York Academy of Sciences* 1403.1 (2017): 48-58.

15. Richards Gary P. “Limitations of molecular biological techniques for assessing the virological safety of foods”. *Journal of Food Protection* 62.6 (1999): 691-697.

16. Lowe Rohan., *et al*. “Transcriptomics technologies*”. PLoS Computational Biology* 13.5 (2017): e1005457.

17. Bevilacqua Marta., *et al*. “Recent chemometrics advances for foodomics”. *TrAC Trends in Analytical Chemistry* 96 (2017): 42-51.

18. Cifuentes Alejandro. “Food analysis: present, future, and foodomics”. *ISRN Analytical Chemistry* (2012): 2012.

19. Hardison Ross C. “Comparative genomics”. *PLoS Biology* 1.2 (2003): e58

20. Friedman Nir and Oliver J Rando. “Epigenomics and the structure of the living genome”. *Genome Research* 25.10 (2015): 1482-1490.

21. Lanham-New Susan A., *et al*. “Introduction to human nutrition”. *John Wiley and Sons* (2019): 12-23.

22. Dauncey, Margaret Joy. “Genomic and epigenomic insights into nutrition and brain disorders”. *Nutrients* 5.3 (2013): 887-914.

23. Lancova Katerina., *et al*. “Detection of hazardous food contaminants by transcriptomics fingerprinting”. *TrAC Trends in Analytical Chemistry* 30.2 (2011): 181-191.

24. Noori-Daloii M R and A Nejatizadeh. “Nutritional transcriptomics: An overview”. *Genomics, Proteomics and Metabolomics in Nutraceuticals and Functional Foods* 43 (2015): 545-556.

25. Schweigert Florian J. “Nutritional proteomics: methods and concepts for research in nutritional science”. *Annals of Nutrition and Metabolism* 51.2 (2007): 99-107.

26. Ryan Elizabeth P.., *et al*. “Advances in nutritional metabolomics”. *Current Metabolomics* 1.2 (2013): 109-120.

27. Altekruse S F., *et al*. “Emerging foodborne diseases”. *Emerging Infectious Diseases* 3.3 (1997): 285.

28. Nollet Leo ML and Fidel Toldrá eds. “Food analysis by HPLC”. *CRC Press* (2012): 11-16.

29. Mishra Geetesh Kumar., *et al*. “Food safety analysis using electrochemical biosensors”. *Foods* 7.9 (2018): 141.

30. Klančnik Anja., *et al*. “PCR in food analysis”. *Polymerase Chain Reaction. In tech*. 10 (2012): 195-220.

31. Joshi Rachana R., *et al*. “Hyphenated Technique-A Boon to Analytical World”. *International Journal of Pharmaceutical Sciences and Research* 3.11 (2012): 4184.

32. Nedovic Viktor., *et al*. “An overview of encapsulation technologies for food applications”. *Procedia Food Science* 1 (2011): 1806-1815.

33. Kimura Hiroshi. “Histone modifications for human epigenome analysis”. *Journal of Human Genetics* 58.7 (2013): 439-445.

34. Vorster Hester H. “Introduction to human nutrition: a global perspective on food and nutrition”. *Introduction to Human Nutrition* 1 (2009): 1.

35. Bashiardes Stavros., *et al*. “Personalized nutrition: Are we there yet?”. *Journal of Pediatric Gastroenterology and Nutrition* 69.6 (2019): 633-638.

36. Mathers John C. "Session 2: Personalised nutrition Epigenomics: a basis for understanding individual differences?: Symposium on 'The challenge of translating nutrition research into public health nutrition'". *Proceedings of the Nutrition Society* 67.4 (2008): 390-394.