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NUTRIGENOMICS IN THE ERA OF OMICS TECHNOLOGIES: CURRENT TRENDS AND INNOVATIONS

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ABSTRACT

Both genetics and nutrition have a significant impact on human health and the course of disease. Certain people and populations may have a higher risk of disease as a result of the interplay of genetic and nutritional factors. Diet-gene association studies have recently provided evidence to support the results of gene-specific dietary intervention trials. A new approach to nutrition is provided by nutrigenomics, which has made it possible to clarify how food affects the genetic code, how the organism reacts to these disruptions and how these affect the phenotypic. Numerous factors, including age, sex, physical activity, smoking and genetics, might affect how a person reacts to their food. Additionally, individualised nutritional counselling based on nutrigenomics emerged as a result of advancements in nutrition sciences, marketing and communication. Finding people who benefit from a certain nutritional intervention and finding alternatives for those who do not are the objectives of personalised nutrition. The way doctors and other professionals assess and treat various diseases has improved since the advent of nutrigenomics. The literature on how diet affects whole-body metabolism-that is, genes, proteins and metabolites-as well as how genotype affects nutritionally associated diseases, has been compiled in this study.

KEYWORDS

Nutrition, Nutrigenomics, Genetics and Chronic Diseases.

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INTRODUCTION

Nutrigenomics

This is a new and developing field of study that weaves a web of connections between gene activity and diet. Nutrigenomics holds that the body has a completely different signalling system that predisposes to gene expression; nutrients are the stimuli or "dietary signals" that are picked up by the cell's sensory systems and have a direct effect on patterns of gene, protein, and metabolite expression[1]. In order to better understand diet-related disorders, nutrigenomics also attempts to demonstrate how nutrition affects the body's homeostasis. In a similar vein, it seeks to discover specific cellular level interactions that fuel the inflammatory stress pathways. The study of nutrigenomics sheds light on how genes and bioactive substances from various food sources interact. Furthermore, biomarkers-the "stress signatures" that predispose to diet-related diseases—are found and detected through the application of nutritional systems biology[2]. Everyone reacts differently to the same food regimen, as is widely known. Genetic variations may be the cause of variances in the risk of contracting diseases. At the gene level, all individuals are 99.9% identical; typically, phenotypic changes result from 0.1% sequence variance (Nicastro *et al*, 2012)[3]. Genetic variation across individuals affects how the body absorbs, processes, stores, and eliminates nutrients (Reen *et al*, 2015)[4]. A single nucleotide polymorphism (SNP) is responsible for more than 90% of all human genetic variations. According to Nicastro *et al*, (2012)[3], individuals have between 5 million and 8 million SNPs[3]. Nutrients and food have an impact on genome evolution mutations, which increases a person's vulnerability to a given disease. A nutritious diet contains ligands, which are unique molecules that activate genes that prevent disease and deactivate those that cause it.

Fenech developed the idea of "genome health nutrigenomics," which is the study of how dietary excess or deficiency might result in base sequence or chromosomal-level genome alterations. In order to explain the wide variations in the same disease among individuals with essentially identical lifestyles, it incorporates nutrigenetics, epigenetics, transcriptomics, and other osmic sciences including proteomics and metabolomics (Mead, 2007)[5]. Determining the ideal caloric intake and tissue culture medium concentration to preserve the least amount of genomic damage is the primary objective of this specific study field (Fenech, 2007)[6] Studies that track the impact of a particular diet frequently ignore the potential role of genetic variability within the cohort under study. Conversely, some studies that examine the impact of candidate gene polymorphisms on the trait under study (such as blood pressure or obesity) do not account for diet interference, which can significantly affect the association that is found. This glaring disparity is intended to be addressed by nutritional genomics (Miggiano *et al*, 2006)[7].

Pharmacogenomics, often known as nutritional genomics, is the study of phytochemicals in common foods and how they interact with an individual's genome to influence the balance between health and disease (Srivastava *et al*, 2022)[8].

The fields of nutrigenetics and nutrigenomics have great potential to improve dietary recommendations for the general public, particularly for genetic subgroups and individuals. Professionals frequently struggle to understand how important preventative measures are to maximising health, postponing the start of diseases and lessening their severity. Therefore, the fundamental knowledge was conceived in this study with the intention of applying it to the treatment of illness and the optimisation of health.

TECHNIQUES AND EXPERIMENTAL METHODS FOR NUTRIGENETICS AND NUTRIGENOMICS STUDY

There are several regulatory areas where nutrition can impact the flow of genetic information[9]. [Developments in proteomics, metabolomics, transcriptomics and genomes have made it possible to comprehend the effects of bioactive substances on human health more quickly and thoroughly. By using these various technologies in cell culture and animal or human research, dietary bioactive substances can be evaluated for their possible health-promoting qualities. Every experimental strategy has its own advantages and disadvantages. Therefore, to comprehend the function of certain nutrients and dietary bioactives in preserving the best possible human health, a mix of in vitro, animal, clinical, and epidemiologic investigations is required. The several "omics" technologies must be taken into account in human studies along with information gathered on environmental, clinical, physiological, dietary, lifestyle, and demographic aspects. Understanding the function of gut microbiota and the interactions that occur between the microbiome and host genome is becoming more and more important, which makes both the data collection and analysis process more difficult. Large and complicated datasets can be created, and managing and interpreting them typically requires a systems biology approach with bioinformatics[10]. Such high-throughput datasets are acquired, managed, stored, retrieved and analysed as part of the bioinformatics requirements.

FUTURE PROSLECTS OF NUTRIGENETICS AND NUTRIGENOMICS AND THEIR CONSEQUENCES FOR DIETARY PATTERNS AND RECOMMENDATIONS

It is becoming more and more clear that nutrigenetics and nutrigenomics are playing a key role in the study of how diet affects health outcomes, and that a variety of "omics" technologies and biomarkers can be used to thoroughly assess the effects of nutrients. The validation level of these technologies with regard to health outcomes varies greatly because some are still in their infancy while others are far more developed. It is becoming more and more clear that a person's nutritional needs can be influenced by their gender, life stage and genetic background. However, it is only feasible to translate this knowledge into recommendations based on genotype or at the individual level in a small number of cases (such as galactosemia or phenylketonuria) where the influence of a person's genotype clearly outweighs that of any other factor and is the final determinant of their nutritional and health status. We are gaining a wealth of new information from nutrigenetic and nutrigenomic research, and it will become clearer which genetic factors require special consideration when developing recommendations for significant population prevalence of important genetic subgroups. It will be necessary to combine nutrigenetic-based advice with "omics" biomarkers to determine whether the individualised recommendation truly results in the anticipated nutritional change and health benefit within the individual, as responses to dietary changes can vary significantly amongst individuals, even within genetic subgroups. Future success depends on this iterative validation method. The only method that can guarantee that the knowledge produced by nutrigenetic and nutrigenomic science is appropriately applied and examined is the evidence-based approach. Additionally, as nutrition and preventive medicine become more intertwined, it is critical that geneticists, dieticians and medical professionals receive adequate training in nutrigenetics and nutrigenomics to ensure that their concepts and methods are appropriately applied and not misused.

Assuming that every person would react to the things they eat in the same way is not only naïve, but probably harmful. In order to identify, assess, and prioritise suitably targeted dietary intervention strategies, a far more thorough understanding of nutrient-gene interactions and their impact on phenotype will be necessary for the development of a personalised approach to nutrition for disease prevention and therapy. Uncovering the relationship between nutrigenomic diseases will not be simple, but the consequences for public health are significant.

It is crucial to think about whether personalised, personalised advice can benefit public health. How much would individualised counselling and nutrition cost? Will a customised diet inspire individuals to follow it? Will individuals who are wealthy and educated be able to afford this strategy? The use of nutrigenetics and nutrigenomics in public health guidance carries inherent hazards. These include promoting a naive understanding of the part genes play in health and weakening the message of healthy eating in general. The public is currently somewhat confused and immune to communications that promote controversial advice, like "eat fewer calories" or "get more exercise". However, over time, these areas of study might be the only means of optimising nutrition for the best possible outcomes in terms of health, wellbeing and a slowdown in the ageing process.

NUTRITIONAL SCIENCES' USE OF OMICS TECHNOLOGIES TO COMPREHEND THE MECHANISMS OF ACTION OF DIETARY FACTORS AND METABOLITES

In recent years, "omics" technologies like proteomics and transcriptomics (such as gene expression arrays) have become more important in the biological, clinical and nutritional sciences. In an effort to identify the molecular processes underlying the health consequences of dietary components or nutrition-related illnesses such colorectal cancer, obesity, diabetes, cardiovascular disease, or inflammatory bowel disease, these technologies are widely used[11]. Global transcript and protein studies are made possible by these technologies and bioinformatic analysis can be used to find potentially new pathways in the progression of disease or to detect novel connections between genes, proteins and nutrients. Although it is becoming easier to apply these technologies, there are still a number of difficulties in analysing the complicated, massive data sets that are produced. The possible interaction of a selected food with the 30,000 genes in the human genome or the 100,000 distinct proteins thought to be translated, for instance, highlights the intricacy of the research. For the analysis and interpretation of these datasets, it is therefore crucial to integrate statistics and bioinformatics with biology, which calls for the abilities, know-how, and experience of a multidisciplinary team. We present the findings from gene and protein expression (i.e. transcriptomic and proteomic) studies in colorectal cancer cell lines examining the effects of butyrate, a metabolite produced in the colon by bacterial fermentation of dietary fibre or resistant starch, to demonstrate how "omic" technologies can offer a deeper understanding of potential molecular mechanisms underlying nutrigenomic effects [12,13].

Technologies for Omics in Nutrigenomics

Genomics: genome-wide association studies (GWAS) and next-generation sequencing

Transcriptomics: RNA sequencing and gene expression analysis

Proteomics: study of protein expression and alteration

Metabolomics: metabolite analysis and metabolic profiling

Obstacles and Prospects

Data analysis and integration: difficulties combining several omics datasets

Clinical practice translation: obstacles to clinical practice translation of nutrigenomics research

Ethical issues: possible moral ramifications of nutrigenomics studies and uses

Future research directions: prospective fields of study, include creating individualised dietary guidelines based on genetic profiles.

Current Nutrigenomics Trends

Personalised nutrition: nutritional advice based on individual genetic profiles

Diet-gene interactions: comprehending the chemical processes that underlie these relationships

Nutrigenomics and disease prevention: uses in long-term conditions like diabetes, heart disease, and obesity

Nutrigenomics and cancer: comprehending how nutrition and genetics contribute to the onset and management of cancer

New Developments in Nutrigenomics

Systems biology methods: using various omics data to comprehend intricate biological systems

Applications of AI and machine learning in data analysis and diet-gene interaction prediction

Gene editing technologies: possible uses in nutrigenomics, including disease prevention gene editing

Microbiome research: comprehending the gut microbiome's function in disease prevention and diet-gene relationships

PERSONALISATION NUTRITION

The idea of customised nutrition

Personalised medicine takes into account a patient's unique genetic makeup and other relevant biological characteristics when determining the best course of therapy for them[14]. Technology has advanced recently, particularly in the areas of genomic analysis and genetic testing. These developments have made it easier to identify particular gene variations that may affect medication metabolism, a person's response to medical interventions, and their vulnerability to particular illnesses. These technologies provide vital information that can help medical practitioners make better judgements about the drugs they recommend, how much to take, and how to treat patients. Similar to this, the idea of personalised nutrition acknowledges that people have unique physiological and genetic traits that influence how they react to various foods and nutrients (Figure No.1)[15]. These results raise the possibility that customised eating habits could have a greater impact on behaviour change and long-term health consequences, as further shown by Ordovas *et al*,[16]. The term "personalised nutrition" refers to a strategy approach that involves creating a customised set of dietary advice, goods, or services while accounting for each person's particular traits. In scholarly literature, "precision nutrition" is frequently used interchangeably with "personalised nutrition"[17]. This strategy helps people achieve a long-lasting change in eating habits that is beneficial to their general health, claim Gibney *et al*,[18]. The concepts of "personalised nutrition" and related terminology like "precision nutrition," "nutrigenomics," "personalised nutrition," "tailored nutrition," and "stratified nutrition" share some similarities. Examples of specific phrases being used interchangeably in this context include "customised nutrition" and "personalised adapted nutrition." Offering appropriate dietary advice to particular people is the main goal of all terms[15,19,20].

MECHANISM OF ACTION

"Receptors" are cellular proteins that both receive and transmit information. The portion of the cell that can reprogramme the cell to adapt to the changing environmental conditions must then get this information from the receptors via a transducing mechanism. Either the cytoplasm or the nucleus of the cell may undergo this reprogramming. Changes in messenger RNA and protein stability, protein function, or gene expression (transcription and translation) may all be involved. Specificity is the fundamental idea underlying how nutrients regulate gene expression. Every receptor needs to be able to specifically bind a nutrient-signalling molecule and start an adaptive change. According to reports, up until recently, the control of gene expression in reaction to dietary.It was believed that hormones and/or the neurological system were the main mediators of the environment. But over the past ten years, there has been proof that important nutrients (such glucose, fatty acids, and amino acids) or minor nutrients (like iron and vitamins) or their metabolites control hormone-dependent gene expression (Walker, 2004)[21]. Celiac disease, phenylketonuria and NTCDs (Non Transmissible Communicable Diseases) such diabetes, cancer and lipidomics are all linked to food consumption (Daniell, 2012)[22]. In this sense, a person's health will be determined by the way their genes and diet interact (Liew and Quinan, 2011)[23].

Figure No.1: "Omics" sciences used in understanding the relationship between nutrition versus health versus disease (Adapted from Sales *et al*, (2014)[24], Lorenzo (2008)[25], Costa and Rosa (2011)[26].

NUTRIGENOMICS METHODOLOGY

A review of the literature the following keywords were used to search the Medline and PubMed databases: "diet," "chronic diseases," "genetics," "nutrition," "nutrigenomics," "nutritional genomics" and "chronic periodontitis." Without regard to linguistic restrictions, all keywords were limited in the abstract or title. For the current review, only extremely pertinent publications from both manual and electronic databases were chosen. This review's objective is to draw attention to the part that genetics and diet play in both human health and the development of disease.

REVIEW OF LITERATURE

Nutrigenomics Principles

The study of how nutrients impact genes-that is, how they alter gene expression and function-and how genes impact diet-that is, what a person consumes and how they react to nutrition-is known as nutrigenomics. The entire range of research methodologies, from clinical trials, epidemiology, and population health to fundamental cellular and molecular biology, can be included in nutrigenomics. The physical and functional unit of heredity that parents pass on to their children is called a gene. DNA segments called genes hold the instructions needed to make a particular protein. Changes in the structure and function of proteins can arise from mutations in the DNA. Single nucleotide polymorphisms (SNPs), which are changes in a single nucleotide, are one of several kinds of genetic variations. A gene's different forms at a certain chromosomal region are called alleles. The mix of maternal and paternal alleles determines an individual's genotype, or genetic identity for a particular genomic location. Genotypes differ from phenotypes in that they do not always manifest as external traits. A phenotype is an identifiable characteristic of a person, such as their hair colour, elevated blood sugar levels, or the existence of an illness. Because of their varied surroundings, people with the same genotype may exhibit various phenotypes. Groups of genetic polymorphisms are frequently inherited together because a haplotype is a collection of alleles that are inherited together. Maintaining the health of a population with varying dietary needs is the goal of nutrigenomics. Consequently, the Human Genome Project was established[27]. The Human Genome Project (HGP) came to several conclusions regarding the impact of nutrients on food, including the following: 1. Will a person's health be impacted by the way their genes are expressed in response to cellular metabolic processes? 2. Do genotype, environment, and nutrition interact to determine gene expression and metabolic response? 3. By comprehending how this gene-nutrient interaction process takes place, individual diet recommendations may be made.

NUTRIGENOMICS APPLICATION

To improve the nutritional value and stability of soybean seed oil for human consumption, the microsomal desaturated gene from soybeans was isolated. It was shown that soy protein extract supplementation is important in controlling the transcriptional level of fibroin gene expression because postpone supplementation increases the transcription of fibroin mRNA, which in turn increases the synthesis of silk by Bombyx mori L. There is no discernible difference between fish given fish meal (FM) and SBM diets, according to nutrigenomic investigation of the intestinal response to partial soya bean meal (SBM) substitution in juvenile Atlantic halibut (Hippoglossus L.)[28]. Using mechanism-based, cutting-edge, modern techniques, a dialyzed aqueous extract of fenugreek seeds was tested in vitro for hypoglycemic potential and its effects on insulin signalling pathways in the two main insulin targets, adipocytes and liver cells[28]. An important oilseed crop, Brassica juncea, was genetically engineered in order to successfully fortify human diets with natural α-tocopherol. Consuming more α-tocopherol than the recommended daily allowance (RDA) is linked to a lower risk of cardiovascular illnesses, enhanced immunological function and a slower rate of progression of certain degenerative human diseases. Diabetic retinopathy can be prevented and/or treated using curcumin and turmeric, which is a dietary source of this compound. Both real-time polymerase chain reaction (PCR) and immunoblotting analyses of vascular endothelial growth factor (VEGF) expression demonstrated that curcumin and its dietary source, turmeric, can reduce VEGF expression in the retina of diabetic rats induced by streptozotocin (STZ)[29].

THE DIFFICULTIES AND POSSIBILITIES OF NUTRIGENETIC AND NUTRIGENOMICS

Nutrigenomic and nutrigenomic techniques are beginning to show their potential. Much progress has already been made, and by using new analytical tools to analyse the data that has already been generated, it has been possible to learn more about the biological processes at play overall as well as to obtain lists of gene products and metabolites that change in response to specific conditions. The field of "epigenomics" is another new issue that could have an impact on how obesity research advances. This is the study of heritable epigenetic cues that alter gene expression and are encoded in chromatin patterns of DNA methylation and histone acetylation. Even identical twins may eventually have different susceptibilities to harmful environmental elements since epigenetic marks have recently been demonstrated to vary in response to environmental influences over an individual's lifespan. Exploring the significance of epigenetic changes as potential causes and consequences of obesity will be conceivable as the enormous job of mapping the human epigenome advances.

PARTICULAR AREA IN WHICH NUTRIGENOMIC TECHNIQUES HAVE BEEN ESSENTIAL

Our basic knowledge of the molecular foundations of cardiometabolic health has improved as a result of the application of nutrigenomic approaches. Despite tremendous advancements, there are still a lot of unanswered questions. Despite this, there are unmistakable instances where using nutrigenomic approaches has greatly advanced our understanding. Using examples from the available literature, we illustrate the kinds of contributions made possible by the application of nutrigenomics in the section that follows.

Cardiac metabolic health

Tissue-specific insulin resistance is a concept that has emerged because insulin resistance can occur concurrently in several organs, while its severity may vary by organ[30]. This idea has advanced considerably with the use of metabolomics, lipidomics, and transcriptomics, which have shown profiles that represent various phenotypes of insulin resistance. The total of plasma triacylglycerol (TAG) and diacylglycerol, as well as lower levels of odd-chain and very long-chain TAG, were positively correlated with hepatic insulin resistance in women[31]. Men did not exhibit this deterioration of the lipid profile. Blaak and colleagues showed that genes related to extracellular remodelling were upregulated in people with hepatic insulin resistance, while genes related to inflammation were upregulated in people with muscle insulin resistance, using RNA sequencing to measure adipose tissue gene expression in two separate cohorts[32]. Based on these and other findings, the authors hypothesised that muscle insulin resistance and elevated inflammatory adipose tissue gene expression are linked to an elevated systemic inflammatory profile. These investigations unequivocally show how metabolomics and gene expression analysis can be used to characterise various phenotypes. In the end, more precise dietary recommendations will be possible with a deeper comprehension of the molecular mechanisms behind these symptoms. The idea that those with muscular insulin resistance benefited more from a Mediterranean diet than people with hepatic insulin resistance is, in fact, already supported by research[33]. Sustained work in this field will open the door for the advancement of precision feeding strategies.

Research on weight loss

The literature has long acknowledged that different people react differently to weight loss research, and that a better understanding of the metabolic The idea that those with muscular insulin resistance benefited more from a Mediterranean diet than people with hepatic insulin resistance is, in fact, already supported by research[33]. Sustained work in this field will open the door for the advancement of precision feeding strategies.

Research on weight loss

The literature has long acknowledged that different people react differently to weight loss research, and that a better understanding of the metabolic changes that take place during weight loss and their relationship to better health metrics is relevant. In light of this, several research have used nutrigenomics methods to investigate molecular alterations after weight loss. The research that use metabolomics are particularly noteworthy. The association between microbial-derived metabolites and improvements in glucose metabolism and diabetes-related amino acids was investigated by Heinz and colleagues[34] using the weight reduction research POUNDS Lost. Significant improvements in fasting insulin and insulin resistance, as assessed by HOMA-IR, were linked to larger reductions in choline and carnitine. The findings bolster the significance of the microbiota and specifically the function of metabolites generated from microbes-in weight loss. More research is necessary because the data do not yet support a causal influence of the metabolites.

Food intake biomarkers

The reliability of some of the basic methods used in nutrition science and nutrition epidemiology has been questioned in recent years due to methodological concerns surrounding food intake measurement[35]. As a result, new, impartial methods for measuring food intake must be developed immediately. The study of dietary biomarkers-more especially, food intake biomarkers-has since taken off. The use of metabolomic technologies to evaluate biomarkers associated with food intake is essential to the field's progress. The Football collaboration created validation criteria for potential biomarkers after reviewing the literature on a variety of diets[36,37]. The current review is not equipped to cover the entire spectrum of biomarkers that have been found. It is important to note, however, that biomarkers are now available for certain foods, including as coffee, red meat, and citrous[38-41]. Nevertheless, further investigation is necessary to find biomarkers of a wider variety of foods and metabolomics is expected to be a crucial component of this. Despite the need to find more biomarkers, strategies that employ these biomarkers to provide information about food intake or enhance the current dietary assessment techniques must also be developed. The potential of food intake biomarkers is demonstrated by the numerous instances in which they have been utilised to categorise people into consumers and non-consumers. However, the biomarkers must be more valuable than the existing self-reported approaches in order to have a significant impact on the field of human nutrition. There are currently few examples of using biomarkers to enhance self-reported data; in order to optimise the impact, future research should address this. However, a few instances demonstrate the potential of biomarkers of food intake. An intervention research was used to determine the dose-response relationship between grape intake and urine tartaric levels. With a 0.9 correlation between the estimated and real intake, tartaric acid concentrations in urine could be used to determine grape intake[42]. Citrous consumption has also been connected to urine proline betaine levels. In order to determine citrous intake from urine samples, our research group created calibration curves using a controlled dietary intervention[43]. Additionally, the self-reported intake and the biomarker-estimated intake showed high concordance. Both of these cases lend credence to the idea that food intake biomarkers may be used to estimate food intake, so validating current self-reported data and possibly enabling the combination of the two methods.

Food intake biomarkers are also expected to play a role in evaluating dietary patterns and how they relate to various health metrics. Specifically, food intake biomarkers may be utilised to investigate associations with health outcomes in prospective cohort studies if they accurately reflect dietary patterns.

GENOTYPE AND NUTRIGENOMICS VS MICROBIOMICS

Nutrigenomics refers to the methods used to study how genes and dietary factors interact to alter phenotype, as well as the results of these interactions. On the other hand, it also investigates how these components are converted into nutrients and bioactive substances by genes and their by products. Nutrigenomics' main goal is to improve health outcomes by customising nutritional recommendations for each person. At the same time, it is necessary to provide strong approaches to understand the complex interactions among dietary compounds, genetic variations, and the whole organism[44].

According to the International Society of Nutrigenetics/Nutrigenomics, there should be three different degrees of personalised nutrition in the future. Conventional nutrition, which takes age, gender, and social variables into account and is based on broad recommendations designed for particular demographic groups, is the first level. Beyond this, the second level presents individualised nutrition, which uses phenotypic data to evaluate each person’s present nutritional state. Lastly, genotype-directed nutrition, the third level of personalised nutrition, takes into account both common and uncommon gene variations when creating dietary recommendations[45].

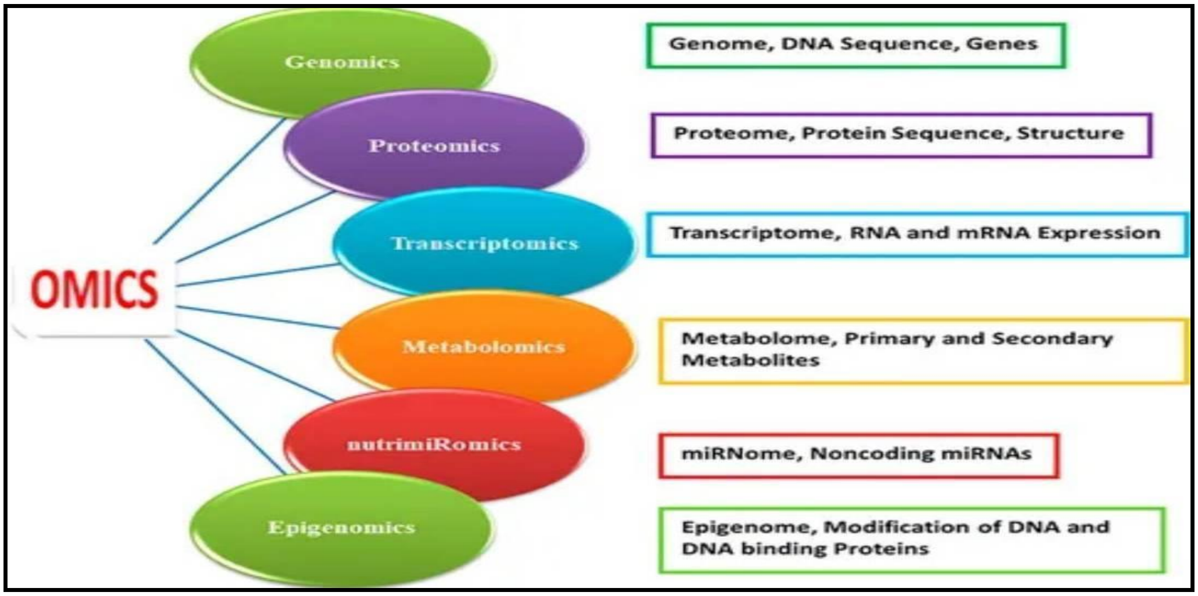
UTILISING NUTRITIONAL GENOMICS TO PRODUCE GENETICALLY MODIFIED FOOD

The creation of functional foods can benefit from an understanding of nutrigenomics. By changing certain genes, it is possible to commercially create transgenic organisms or foods that are advantageous for both general health and specific medical diseases[46]. The creation of functional meals that promote particular health benefits is linked to the start of the post-genomic era. These health claims are supported by advanced technologies such as DNA chip technology implemented in an integrated manner on an omics platform, which aims to give society a balanced diet that is rich in nutrients and variety[47]. By reducing undesirable chemicals like phytic acid and acrylamide amino acids, the use of advanced technologies like genomics, proteomics, and metabolomics to increase crop yield and improve functional food sources on the market can further improve nutrition[48-51].

FUTURE DIRECTIONS AND OBSTACLES IN NUTRITION

Particularly in studies pertaining to health and nutritional outcomes, nutrigenetics and nutrigenomics are becoming more and more significant. One can thoroughly examine the effects on nutritional status by utilising biomarkers and "omic" technologies. While certain technologies are still in their infancy, others are well-established and have demonstrated efficacy. It is now clear that nutritional requirements are significantly influenced by knowledge about an individual's genotype or species. Therefore, dietary recommendations based on an individual's genotype are only useful in specific situations where the genotypic influence surpasses other factors, such as the individual's nutritional and health state. As time goes on, it will become more evident which genetic traits should be given particular weight when developing dietary recommendations for major subgroups based on genetic data. Nutrigenomics evidence-based studies are producing a deluge of fresh knowledge. Even within a same genetic subgroup, research has effectively demonstrated the wide range of reactions to dietary modifications. Therefore, it can be said that working together with "omics" biomarkers and nutrigenetics-based guidance is crucial when it comes to personalised nutrition that aims to improve a person's health[52].

Therefore, before using nutrigenetic/nutrigenomic technology and properly evaluating it for success, an evidence-based approach is crucial. Since nutrition and preventive medicine have an integrated approach, dieticians and medical professionals should increase their expertise in the subject topic through relevant sources to ensure that their ideas are used practically and that they are not exploited. Since each person responds to food in a unique way, it is advised to use focused intervention techniques in order to gain a thorough grasp of how nutrient-gene interactions impact phenotypic. Additionally, this data is quite useful for creating a customised strategy that focuses on nutrition primarily for illness prevention and treatment development. Uncovering the link between nutrigenomic diseases will be challenging, but the consequences for public health are enormous. Evaluating whether tailored individual guidance can advance public health is essential.



Omics

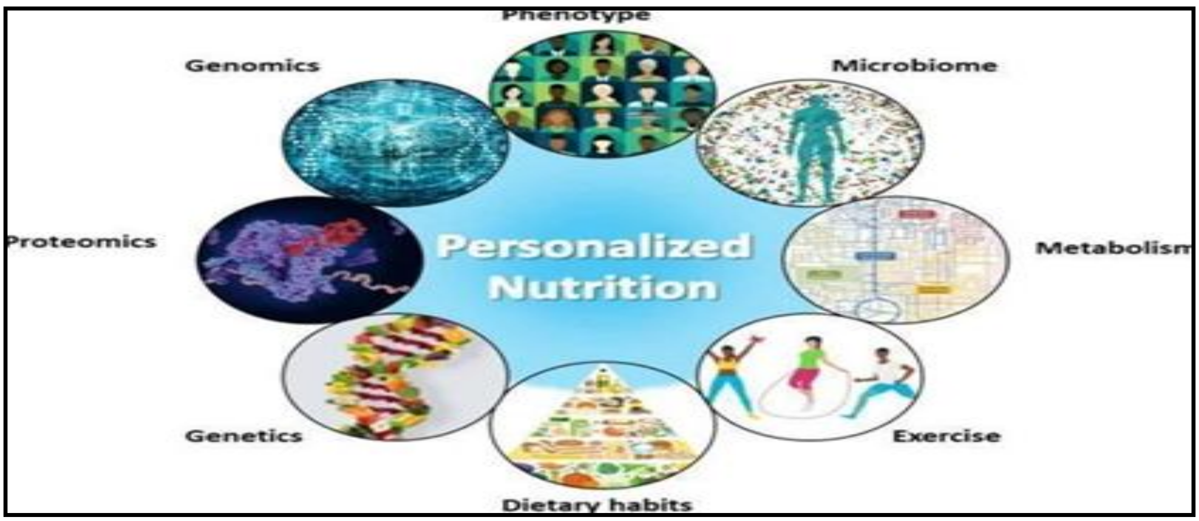
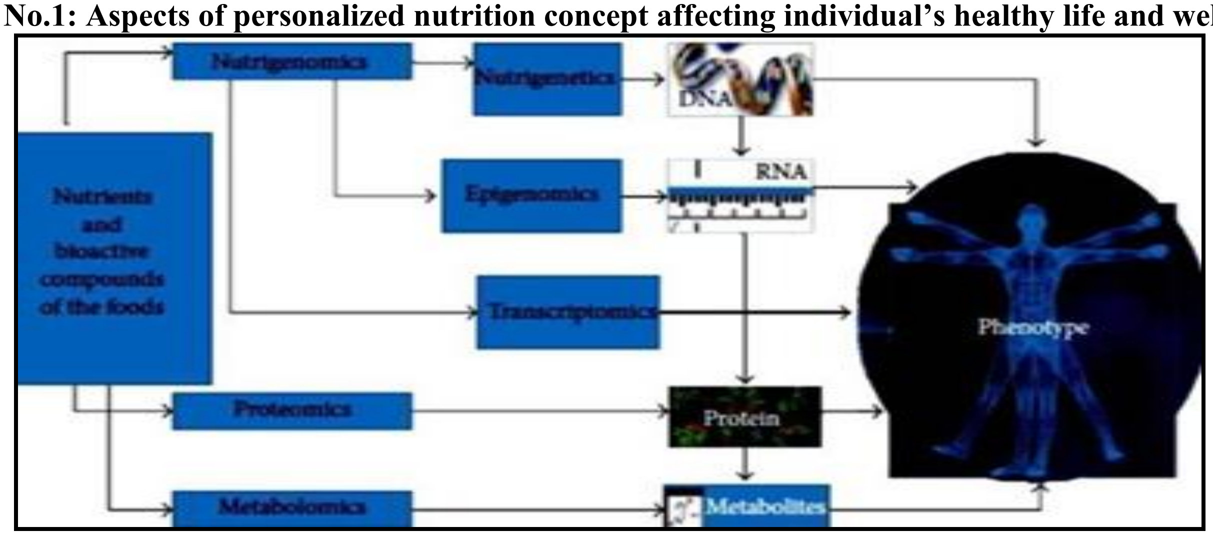


Figure No.1: Aspects of personalized nutrition concept affecting individual's healthy life and well-being



Mechanism of action

Nutrigenomics

CONCLUSION

Nutrition may now be approached in a new way thanks to nutrigenomics, which also clarifies how food affects the genetic code, how the organism reacts to these disruptions, and how the phenotypic is affected. Additionally, individualised nutritional counselling based on nutrigenomics emerged as a result of advancements in nutrition sciences, marketing and communication. In addition to altering dietary patterns and enhancing lifestyle choices, individualised nutritional counselling will primarily help with disease diagnosis, slow the progression of chronic conditions and aid in the treatment of other conditions.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest related to this study.

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