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An unprecedented concept: Nutrigenomics in periodontics

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Abstract
Periodontitis is a ubiquitous chronic inflammatory disease affecting supporting structures of the teeth. Nutrition plays a very significant role in man's development, health and welfare, therefore nutrition has correlation to the natural resolution of the periodontal diseases. Genes are important in determining the function, but nutrition is able to modify the degree of gene expression A change in dietary pattern represents a promising approach in reducing the risk of aging by modulating gene expression and Prevent Chronic diseases.

Keywords: nutrigenomics, genes, transcriptomics, metabolomics, proteomics

Introduction
Periodontitis is defined as an inflammatory disease of the supporting tissues of the teeth caused by specific micro organisms or groups of specific micro organisms, initiating progressive destruction of the periodontal ligament and alveolar bone with pocket development, recession or both [1].
Periodontitis is a ubiquitous chronic inflammatory disease affecting the supporting structures of the teeth and if not promptly recognised and correctly managed can ultimately lead to tooth loss resulting in reduced masticatory function and subsequent alterations in dietary intake and nutritional status.
The importance of successful management and treatment of periodontitis has gained added press in recent years with the recognition that periodontitis is a risk factor for a number of important systemic diseases, which include cardiovascular disease, diabetes and rheumatoid arthritis [2].
Tooth loss has been associated with nutrient deficiency and changes in food predilection. Investigating the relation amongst nutrients and periodontal disease has been important to understand the potential role of dietary modification in the prevention and treatment of periodontal disease and the ultimate prevention of tooth loss through periodontal disease [3].
The increasing interest in the association between nutrition and periodontal disease is raising due to the improved understanding of the mechanisms behind periodontal tissue destruction, the potential protective role of nutrients and the advent of modern genomic measurement tools have led to a common dietary chemicals act on the human genome, either directly or indirectly, to alter gene expression or structure. Genes are important in determining the function, but nutrition is able to modify the degree of gene expression [4].

What is nutrigenomics?
Nutrigenomics is a branch of nutritional genomics that focuses on identifying and understanding molecular level interaction between nutrients and other dietary bioactives with the genome.

Evolution of nutrigenomics
On 1st April 1869, the first isolation of DNA was made by Friedrich Miescher.
- On 25th April 1953, Watson and Crick published "the molecular structure of DNA".
- In 1997, the first nutrigenomics company was launched.
- In 1999, the name nutritional genomics was changed to genomics by Nancy Fogg-Johnson and Alex Merolli which provides powerful means of discovering hereditary factors in disease. If the genomic era was said to have a precise birth date, it was on April 14, 2003. That was when Human Genome Project [3] was launched with the participation of former U.S President Bill Clinton and former British PM Tony Blair which contained the complete sequencing of the human genome. It was then realized that a new era in biological and medical sciences was beginning. This is often referred to as the 'omics'-revolution.
- In 2004, NuGo (European Nutrigenomics Organization) was born and funded until June 2010.
- In 2007, Nestle Research Center joined the industrial platform of the Kluyver Centre for Genomics of industrial fermentation, Netherlands.
- In 2008, US Berkeley scientist predicted human genome tests within five years for $100 [5].

How nutrigenomics works?
"Nutri" means nutrition and genomics means describes the process by which all genes present in the genome of a given species can be mapped, sequenced and characterized.
Nutrigenomics is an emerging field of science and technology unrevealing inter-relationships between nutrients and human genome using modern tools such as transcriptomics, metabolomics, epigenomics and proteomics.

Nutrigenomics shows a new way of working with nutrition and now, the knowledge of how food impedes with the genetic code and how the organism responds to these interferences and with the phenotype can be explained.

Nutrigenomics is both the examination of how nutrients affect genes (i.e. influence gene expression and function) and how genes affect diet (i.e. what an individual eats and how an individual responds to nutrients).

Practical applications of nutrigenomics

1. Genes and proteins expressed differentially in health and disease that are modifiable by nutrients are identified.
2. Genes, proteins, and metabolites are influenced by specific nutrients that are known to be beneficial or harmful are identified.
3. To identify genes, proteins, and metabolites that are altered by dietary fats associated with cardiovascular disease.
4. To identify genes, proteins, and metabolites that is altered by omega 3 fatty acids.
5. Genetic variations that alter the nutrient-gene interactions in applications 1 and 2 are identified [6]

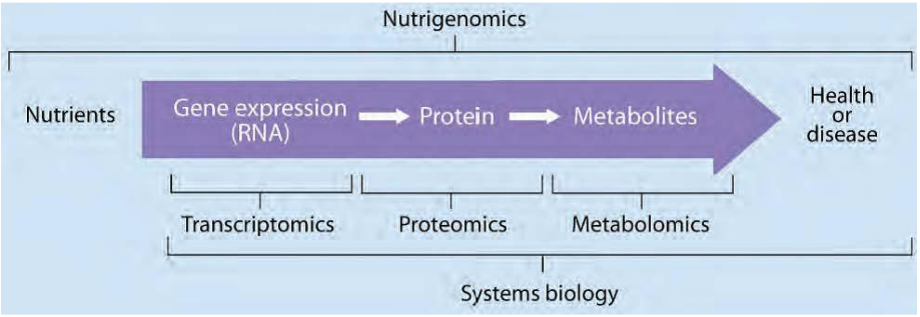

Fig 1: Action of nutrigenomics at various levels of system

Nutrients in gene expression

DNA is made up of genes every gene contains all the information to produce a protein. Genes are read or expressed to produce function. the transcription or reading of genes to produce rna is the first stage of gene expression. The transcriptome is the whole set of rna transcripts. Nutrigenomics by using this omic tools like epignetics, transcriptomics, proteomics & metabolomics modulate the expression of gene. The presence of particular gene or mutation merely indicates a predisposition to a specific disease progression whether that genetic potential will manifest as a disease depends upon elaborate interactions between the genome and environmental factors. Nutrition that is diet is disputably one of the most important environmental factor influencing health & disease. Although genes are critical for defining predilections nutrition modifies the extent to which different genes are expressed and thus prevents expression of disease in an susceptible individual [4].

Nutrigenomics and Periodontics

Periodontitis is initiated by the plaque biofilm, but most tissue destruction results from an abnormal inflammatory immune response in patients predisposed to the condition. The response is characterized by hyperinflammation, which fails to eradicate the causative pathogens and generates prolonged release of neutrophil proteolytic enzymes, proinflammatory mediators and reactive oxygen species (ROS), which in turn destroy the periodontal attachment.

Based on the pathology of periodontal disease the assumption is that these nutrients could modulate periodontal health. Increased production of reactive oxygen species raises requirements for the antioxidant nutrients involved in defense. Antioxidant vitamins (vitamins A, C and E) and trace elements (selenium, copper and zinc), known to be depleted during periods of inflammation, can counteract reactive oxygen species damage to cellular tissues and modulate immune-cell function through the regulation of redox-regulated transcription factors and ultimately affect the production of cytokines and prostaglandins. Moreover, selenium has further important redox functions, with selenium-dependent glutathione enzymes being involved in the reduction of damaging lipid and phospholipid hydroperoxides to harmless products.

Vitamin C acts as a powerful scavenger of free radical. The association between low intake of vitamin C and occurrence of periodontitis has been demonstrated, in a study by Nissada 2010.

Vitamin E terminates free radical chain reaction, stabilizes membrane structure. It is shown to have mitigatory effects on inflammation and collagen breakdown. A low level of vitamin E in gingival tissues of periodontitis patients has been reported. (Offenbacher 1990)

Omega 3 fatty acids such as n-3 PUFA (oily fish), increase the tissue concentration of eico-sapentaenoic acid, deco-sahexaenoic acid and down-regulate inflammation and inhibit bone loss in vitro. (Sun *et al* 2003) Results from a prospective, observational study carried out over 14 years revealed that men with high consumption of wholegrain were 23% less likely to develop periodontitis. (Merchant 2006)

The main functional value of pomegranate in oral health is its polyphenolic flavonoid content. The components of pomegranate juice were found to significantly inhibit cytokine IL-8, PGE_2, nitric oxide, human salivary α-amylase, α-glucosidase activity and found to reduce aspartate ami-notransferase activity in saliva. The hydro-alcoholic extract from pomegranate fruit has shown to decrease the Colony Forming Unit (CFU) per milliliters of dental plaque by 84%. Local action and topical effects of antioxidant agents from pomegranate on the oral tissues have been hypothesis. Periodontitis is associated with low serum/plasma

micronutrient levels that may result from dietary and/or lifestyle factors as well as nutrigenetic characteristics. Primary evidence suggests beneficial results from nutritional interventions, supporting the contention that daily intake of certain nutrients should be at the higher end of recommended daily allowances.

The recommendations of 2011 European Workshop on Periodontology suggested that the dental team should consider including fish oils, fibre, fruits and vegetables and to reduce levels of refined sugars as part of a periodontal prevention / treatment regime and a general health benefit message.(Chapple *et al* 2012) [7].

Conclusion

Diet is an important environmental factor that interacts with the genome to modulate disease risk. A clear understanding of these interactions has the potential to support disease prevention through optimization of dietary recommendations. The interaction between genetic and dietary influences can result in a higher risk of disease in certain individuals and populations. The future of nutrigenomic research promises to provide additional knowledge of biological function and individual response to diet. New food products has been manufactured on the genetic basis considering food been liked or disliked which escort to the development of new food products according to the ethical rules of society, which may lessen the risk of chronic diseases(Corbin and Zeisel, 2012) [8].

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