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NUTRIGENOMICS FOR WELLNESS

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Introduction

Nutrigenomics is the branch of genomic research, which provides a molecular understanding of how common dietary chemicals (i.e., nutrients) affect human health by altering the expression and /or structure of an individual's genetic make up.

Sequencing of the human genome has opened the door to the most exciting new era for the holistic system description of human health. Thus it is now possible to study the underlying mechanisms of human health in relation to diet and other environmental factors such as drugs and toxic pollutants. Technological advances have made it feasible to envisage that in future personalized drug treatment and dietary advice and even tailored food products can be used for promoting health on an individual basis. Recent developments of molecular biology and biochemical methods allows the elucidation of molecular mechanisms of diet constituents on the homeostatic mechanisms in health and disease states. The availability of draft human genome sequence as well as the genome sequence of model organisms combined with functional and integrative genomics approach of systems biology, bring about the possibility to identify alleles and haplotypes responsible for specific reactions to the dietary challenge in susceptible individuals.

Such complex interactions are studied within the newly conceived field the NUTRITION GENOMICS OR NUTRIGENOMICS.

Nutrigenomics An Integrated Science

Nutritional sciences are discovering the application of the so-called 'omics' era. Propelled by recent unraveling of the human genome and the coinciding technological advances, genomics, transcriptomics, proteomics and metabolomics are now available to nutritional research.

With the advanced development in molecular biology, biochemical methods and genome mapping combined with functional and integrated genomic approaches of systems biology brings out the possibility to identify genes responsible for specific reaction to identify challenge in susceptible individuals. Thus nutrigenomics is interplay between genotype, environment and nutrition and the health arena.

Nutrigenetics And Nutrigenomics

This new era of molecular nutrition i.e., nutrient gene interaction can unfold in dichotomous directions.

Nutrigenomics is the effect of nutrients or food bioactive on the regulation of gene expression. Nutrigenetics is the impact of variations in gene structure on one's response to nutrients or food bioactive.

The melding of function genomics or systems biology, into nutrition research has resulted in the integrated discipline of nutrigenomics. The principles of some of the key players in nutrigenomics - Genomics, Proteomics, and metabolomics are briefly discussed below.

Genomics: Uses either classical DNA sequencer technology or more advanced technologies such as DNA arrays. Micro arrays can profile gene expression pattern containing tens of thousands of genes in a single experiment, thus allowing systemic analysis of DNA and RNA variations and providing basic genetic information and insight into any heterogeneity in the coding regions e.g., SNP's or promoters.

Proteomics: Enables researchers to identify all proteins in a cell or organ and detect any post translation modification or change in protein in the protein expression pattern.

Metabolomics: The multistep pathways from genome to phenotype , along with the involved process of identifying gene function, spurs continual technological development and investigation of metabolic path ways or the biochemical profiling that is known as metabolomics.

Tenets Of Nutrigenomics

The conceptual basis of this new branch of

tyramine. Either the food itself contains the chemical or the food causes the release of imflammatory mediators such as histamine. Tyramine, contained in a number of foods, is believed to be a common cause of migraine. Fish based diets contain histamine and foods such as egg white, shellfish, fish, tomatoes etc are known to cause mast cells to release histamine (Finn, 1987). Opiates are well known histamine releasing agents. Exorphins, generated during the digestion of several dietary proteins may also cause some behavioural changes in animals. Histamine content of pet food can range from 0.11 to 65.51 mg/g, being highest in fish based diets. Refrigeration can lead to higher histamine levels in foods because of the conversion of the histidine to histamine.

Nutrition and Neurological pathology

i) Vitamin deficiencies induce disorders of a neurological and behavioural kind. Diseases of the encephalon, following deficiency of thiamine and other vitamins, are of special importance. Cats in particular are subject to group B vitamin deficiency because of the ingestion of foods containing antivitamins ie, thiaminase in fish.

ii) Lysosomal enzymatic defects - The enzyme deficiency alters the normal metabolism of lipids, glycoprotein, glycogen, and mucopolysaccharides, with accumulation of metabolites resulting in injury to the lysosome leading to cell death. It has importance with disorders relating to the production and metabolism of the chemical mediators necessary for the normal functioning of the nervous system.

Nutrition and behavioural disturbances

The functioning of the CNS is depending upon nutrition. In order to form neurotransmitters, the nervous system must remove the necessary precursor molecules ie, amino acids and lecithin from the blood. It has been shown that the dogs fed with high meat diets, are rich in tryptophan, the precursor in the brain. After an abundant meat meal, many of the amino acids are found increased quantities in the blood. The action of amino acids and oligopeptides originating at gastro duodenal level regulate the neurohormonal system. These amino acids and oligopeptides, in relation to the type of nutrition, are generated at gastro duodenal level and have an influence on the nervous system and on behaviour.

Nutrition and aggressiveness

Nutritional science now understands that the aminoacid tyrosine, which is abundantly supplied in protein rich diets, produce dopamine in the brain. Dopamine causes enhanced activity and aggression. Excess of spices, meats and poor quality fats ultimately lead to nervousness, agitation and depletion. Complex carbohydrates and dairy products promote brain chemistry rich in tryptophan, serotonin and melatonin. Tryptophan, the precursor of serotonin, may affect the incidence of aggression, self mutilation and self resistance. The latter may also be influenced by dietary tyrosine, a precursor of catecholamines. When these substances are abundant in the body they promote calmness, deep sleep, strong immunity and a relaxed, focused mind. As diet composition, nutrient availability and nutrient interactions affect the availability of these precursors in the brain, behaviour or stress resistance may be affected (Bosch et al., 2007).

Serotonin plays an important role in the phenomenon of aggressiveness. The consumption of food influences the synthesis of serotonin in the brain. When proteins are ingested in the diet the concentration of tryptophan in the plasma increases, as does the concentration of other animo acids and in particular the large electrically neutral amino acids ie, tyrosine, phenyl alanine, leucine, isoleucine, valine etc. Serotonin is also involved in the choice of foods. Serotonin inhibits aggressiveness in cats. The part played by nutrition in the control of aggressiveness and also irritability, nervousness, is not absolute. Correct nutrition and the regular and frequent administrations of foods have a preventive effect upon undesired aggressiveness.

Nutrition and dyskinesia

The administration of either choline or lecithin results in an increase of acetyl choline in the nervous system. Choline is largely destroyed by the intestinal bacteria and has a fishy smell. Various nervous diseases in man have been treated with choline and lecithin. Good prospects are anticipated

for the use of purified lecithin in degenerative nervous diseases involving a lack of acetyl choline.

Nutrition and alimentary behaviour

Anorexia or absence of hunger is a frequent disorder of dogs and cats. Anorexia due to organic lesions can be distinguished from behavioural anorexia which could resemble mental anorexia in man. Many endogenous substances are involved in the control of both the quality and quantity of the food introduced.

The presence or absence of nutrients or non-nutrients in the gastrointestinal tract and their quality and quantity, produces stimuli of a hormonal or nervous type which influences animal behaviour and short term alimentary behaviour. The proteins and certain amino acids such as tryptophan and also to a limited extent fats, stimulate the release of cholecystokinin (CCK) from the cells of duodenal mucosa. It is the hormone involved in the occurrence of satiety.

After absorption the nutrient principle reaches the liver, the site of metabolic receptors that influence animal behaviour. The stimuli that derive from the liver are predominantly of a nervous type, from osmoreceptors and glucoreceptors. Thus the liver is concerned with the control of hunger and satiety. Recently it has been recognized that the amino acids in the blood are important for the control of hunger and satiety.

Food proteins are one of the most important regulators of the hunger and appetite and their special activity depends on individual amino acids and the way in which they are absorbed. Alimentary behaviour is strongly influenced by the available quantity of food and its quality. Pica or deprived appetite is a central nervous system phenomenon. The most severe case of pica in dogs and cats are accompanied by lesions of the central nervous system when there are also signs of aggressiveness and irritability.

Conclusion

This paper gives an overview of current knowledge on the influence of nutrition on animal behaviour and explores the underlying mechanisms by which diet may affect behaviour in animals. At present, behaviour and diet are linked in psychodietetics, which in turn, correlates to food quality and animal well being, as well as specific behavioural problems. Many studies are being conducted on the relationship between nutrition, neurotransmitter synthesis and neurohormonal system activity, with relative behavioural changes. In particular, data were collected on the relationship between nutrition and aggressiveness, nutrition and psychosis, nutrition and dyskinesia, nutrition and alimentary behaviour in carnivorous domestic animals. Pet's nutrition involves a broader significance than was given by traditional dietetics, including the man animal relationship. Therefore, it is vital that research and development institutions emphasise scientific research on animal psychodietetics.

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