La información para los procesos fisiológicos involucrados en la nutrición se encuentra en el genoma, y determina qué nutrientes y en qué cantidades son necesarios para las respuestas homeostáticas, teniendo como determinante de su expresión final la interacción con la dieta.

La genómica nutricional establece como principal objetivo aportar el conocimiento que permita hacer un diagnóstico y establecer un tratamiento nutricional basado en el genotipo individual, mediante 2 ramas principales: la nutrigenética y la nutrigenómica.
Nutritional genomics is a science studying the relationship between human genome, nutrition and health. It can be divided into two disciplines:

- **Nutrigenomics**: studies the effect of nutrients on health through altering genome, proteome, metabolome and the resulting changes in physiology.

- **Nutrigenetics**: studies the effect of genetic variations on the interaction between diet and health with implications to susceptible subgroups. More specifically, nutrigenomics studies how individual differences in genes influence the body's response to diet and nutrition. For example, people with an enzyme deficiency caused by mutations in the enzyme phenylalanine hydroxylase cannot metabolize foods containing the amino acid phenylalanine and must modify their diets to minimize consumption. With modern genomic data, severe gene mutations with less severe effects are being explored to determine whether dietary practices can be more closely personalized to individual genetic profiles. However, there have been few validated studies for these kinds of classical gene mutation effects.
NUTRIGENOMICA
Concepto

- Not to be confused with Nutrigenetics.

Nutrigenomics is the study of the effects of foods and food constituents on gene expression.[1] This means that nutrigenomics is research focusing on identifying and understanding molecular-level interaction between nutrients and other dietary bioactives with the genome. Nutrigenomics has also been described by the influence of genetic variation on nutrition by correlating gene expression or single-nucleotide polymorphisms with a nutrient's absorption, metabolism, elimination or biological effects. By doing so, nutrigenomics aims to develop rational means to optimise nutrition, with respect to the subject's genotype.

By determining the mechanism of the effects of nutrients or the effects of a nutritional regime, nutrigenomics tries to define the causality|relationship between these specific nutrients and specific nutrient regimes (diets) on human health. Nutrigenomics has been associated with the idea of personalized nutrition based on genotype. While there is hope that nutrigenomics will ultimately enable such personalised dietary advice, it is a science still in its infancy and its contribution to public health over the next decade is thought to be major.[2]
Nutrigenetics is the retrospective analysis of genetic variations among individuals with respect to the interaction between diet and disease. It is an applied science that studies how the genetic makeup of an individual affects the response to diet and the susceptibility to diet-related diseases. This necessitates the identification of gene variants associated with differential responses to nutrients and with higher susceptibility to diet-related diseases. The ultimate goal of nutrigenetics is to provide nutritional recommendations for individuals in what is known as personalized or individualized nutrition. A number of companies have begun offering nutrigenetic testing, but the recommendations are often highly generic, and could provide a false sense of security. As these companies are not offering specific clinical advice, they do not qualify for regulation beyond the accuracy of the genetic test applied. Objections to such testing kits in the UK have led to the voluntary suspension of commercial testing activity there, and in the US severe criticisms have been leveled against various testing companies by the Government Accountability Office.
Understanding the nutrigenomic definitions and concepts at the food-genome junction.

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Abstract

The marked differences in individual response to dietary factors have led to major controversies in nutrition and puzzled nutrition scientists over the last century. The emerging field of nutrigenomics helps us to understand the basis for some of these differences and also promises us the ability to tailor diet based on individual genetic makeup. Great advances in Human Genome Project, documentation of single nucleotide polymorphisms (SNPs) in candidate genes and their association with metabolic imbalances have gradually added new tests to the nutrigenomic panel. Studies based on ethnopharmacology and phytotherapy concepts showed that nutrients and botanicals can interact with the genome causing marked changes in gene expression. This has led to the commercial development of nutraceuticals and functional foods that can modify negative health effects of individual genetic profile bringing the field to the "food/genome" junction. Despite the promise of nutrigenomics to personalize diet, there is skepticism whether it can truly bring about meaningful modification of the risk factors connected to chronic diseases, due to the lack of large scale nutrition intervention studies. Several intervention studies currently underway in the United States and abroad (Israel, Spain, and France) will further help validate nutrigenomic concepts. France has already introduced a National Nutrition and Health Program to assess nutritional status and risk of major metabolic diseases. As the field(s) related to nutritional genomics advance in their scope, it is essential that: (a) strict guidelines be followed in the nomenclature and definition of the subdisciplines; and (b) the state/federal regulatory guidelines be updated for diagnostic laboratories, especially for those offering tests directly to the public (without a physician's request) to help protect the consumer.

La epigenética es el estudio de modificaciones en la expresión de genes que no obedecen a una alteración de la secuencia del ADN y que son heredables. Una de las fuentes de mayores modificaciones de los genes es el factor ambiental y puede afectar a uno o varios genes con múltiples funciones. Por medio de la regulación epigenética se puede observar cómo es la adaptación al medio ambiente dada por la plasticidad del genoma, la cual tiene como resultado la formación de distintos fenotipos según el medio ambiente al que sea expuesto el organismo. Estas modificaciones presentan un alto grado de estabilidad y, al ser heredables, se puedan mantener en un linaje celular por muchas generaciones. Esto es importante ya que cuando hay errores en las modificaciones se pueden generar enfermedades que perduren en una familia por mucho tiempo.
Epigenetics

• Modification to genes other than changes in the DNA sequence
• These changes allow for a different expression of the genes in the offspring
• Various illnesses linked to these mechanisms
  - cancer
  - respiratory diseases
  - autoimmune diseases
  - cognitive dysfunctions
  - cardiovascular diseases
  - etc.
• Epigenetic agents
  - heavy metals
  - pesticides
  - tobacco smoke
  - hormones
  - radioactivity
  - viruses/bacteria

BASIC NUTRIENTS (specially methyl donors)

[Weinhold, 2006; Ferket, 2009].
• Experiments by Randy Jirtle and Robert Waterland (Duke University)

• Agouti yellow mice (excessive eaters, prone to cancer and diabetes) 
  (Ferket, 2009)

GROUP 1-Dams were fed diets rich in Methyl donors

Offspring: brown, slender, NOT prone to cancer/diabetes

GROUP 2-Dams were fed normal diets

Offspring: yellow, obese prone to cancer & diabetes

GROUP 1 - Hens fed L-Carnitine from 21 weeks of age

Offspring: smaller fat pads

GROUP 2 - Hens fed normal diets

Offspring: larger fat pads
Epigenetics in Layer Nutrition

• Work of Milton Scott (1960’s and 1970’s) showed that the choline requirement of mature laying hens can be modulated by early choline nutrition.

• Oviedo-Rondon et al. (2006a). Heat stress during incubation affects hormonal control of bone growth in meat birds, and the impact may last through the life-time of the bird.

✓ What are the implications as it relates to Ca and P metabolism (shell quality, cage fatigue) in the mature laying hen?
Possibilities for Epigenetics

• Develop nutritional programs to respond to factors that may affect gene expression

• Proactively develop nutritional programs to impact gene expression

• Develop breeding systems that will consider that the expression of specific genes in the various strains can be modified

Adapted from Ferket, 2009
Trends in Genetic Improvement

Production Traits
- Persistency of production
- Livability: through field tests
- FCR: increased egg mass vs. lower intake

Behavior Traits
- Reduced cannibalism
- Improved feathering covering
- Increased use of nests

Egg Quality
- Shell Color
- Shell Strength
- Albumen Quality
- Egg Solids

Most will have an impact on nutritional programs

Van Sambeek, 2008
0'Sullivan, 2009
0'Sullivan, 2009