Gene Expression Fundamentals: Personalized Age Defying Skin Care

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Objectives

To introduce an emerging trend in age defying cosmetics, personalized skin care

Describe the general principles of gene expression as it relates to personalized anti-aging products

Current status, is this science sufficient to support a viable business, today or in the future
What is a Gene?

DNA

The majority of living organisms encode their genes in long strands of deoxyribonucleic acid (DNA).

DNA consists of a chain made from four types of nucleotide subunits, each composed of:

- D= a five-carbon sugar (2'-deoxyribose),
- One of the four bases **adenine**, cytosine, guanine, and thymine and
- A phosphate group (nucleotide when attached to above)

Nucleic acid means a long chain of the above, hence DNA
DNA Base Pairs

There are chemical cross-links between the two strands in DNA, formed by pairs of bases.

They always pair up in a particular way, called **complementary base pairing**;
- thymine pairs with adenine (T–A)
- guanine pairs with cytosine (G–C)

This arrangement creates the spiral structure of DNA

From: http://www.bbc.co.uk/education/guides/zvb7hyc/revision/2

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.....in RNA the important base pairs are:
- adenine (A) pairs with uracil (U)
- guanine (G) pairs with cytosine (C)

A gene is:

A unit of DNA that is usually located on a chromosome and that controls the development of one or more traits.

The *basic* unit by which *genetic* information is passed from parent to offspring.

The DNA of a normal human cell contains an estimated 30,000 to 120,000 genes.

Gene expression: A gene's DNA is **transcribed** into mRNA which is, in turn, **translated** into protein.
Every three base pairs codes for a specific amino acid
The entire gene specifies a sequence of amino acids, this is a protein
About 3 billion base pairs
What is a Polymorphism?

A combination of the Greek words *poly* (meaning multiple) and *morph* (meaning form), polymorphism is a term used in genetics to describe *multiple forms of a single gene* that exists in an individual or among a group of individuals.

Polymorphism refers to the fact that the multiple forms of a single gene must occupy the same habitat at the same time (*excludes specific geographical, race or seasonal morphs*).

Polymorphism promotes diversity and persists over many generations, because no single form has an overall advantage or disadvantage over the others in terms of natural selection.

https://www.thebalance.com/genetic-polymorphism-what-is-it-375594
Current Approaches to Develop Personalized Cosmetics for Anti Aging

Evaluate genes and SNP’s associated with one’s ability to:

• Ability to counter oxidative stress
• Collagen formation/potential for advanced glycation end products (wrinkle formation and collagen degradation)
• Pigmentation (natural skin color, ability to tan or burn)
• Tendency to develop sun/age spots
• Skin Hydration
• Susceptible to inflammation and allergy
• Skin texture and elasticity (cellulite, stretch marks)
• Skin nutritional needs (vitamin deficiency)
• Omega-3 and Omega-6 deficiency (fatty acid deficiency can promote dry skin, inflammation, acne, dermatitis...)

Gene expression fundamentals personalized skin care
SNPs are single-nucleotide substitutions of one base for another.

Each SNP location in the genome can have up to four versions: one for each nucleotide, A, C, G, and T.

Not all single-nucleotide changes are SNPs, though.

To be classified as a SNP, two or more versions of a sequence must each be present in at least one percent of the general population.

SNPs occur throughout the human genome, roughly in every 300 nucleotide base pairs.

This translates to about 10 million SNPs within the 3-billion-nucleotide human genome.
Different Classifications of SNP’s

- **Linked SNPs**
  - outside of gene
  - no effect on protein production or function

- **Causative SNPs**
  - in gene
  - Non-coding SNP:
    - changes amount of protein produced
  - Coding SNP:
    - changes amino acid sequence

Key Points to Remember

SNPs do not always affect the way a protein functions.

SNPs are divided into two main categories:

**Linked SNPs** (also called indicative SNPs) do not reside within genes and do not affect protein function. Nevertheless, they do correspond to a particular drug response or to the risk for getting a certain disease.

**Causative SNPs** affect the way a protein functions, correlating with a disease or influencing a person's response to medication. Causative SNPs come in two forms:

**Coding SNPs**, located within the coding region of a gene, change the amino acid sequence of the gene's protein product.

**Non-coding SNPs**, located within the gene's regulatory sequences, change the timing, location, or level of gene expression.
Testing and product guidance

DNA4LIFE
Geneu (England)
SkinDNA
Targetedskin.com
SKINSHIFT
Genemarkers

Ancestry®
23andMe®

........ other facilities can be found online
Using Gene Expression Data

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SNP’s can slightly modify the DNA structure

Generally they always pair up in a particular way, called **complementary base pairing**;
- thymine pairs with adenine (T–A)
- guanine pairs with cytosine (G–C)

SNP’s are very common and this is how one can identify long lost relatives, and common body including skin similarities and differences in diverse populations.
Genes do not work in isolation

Understanding the mechanism of the IRF4 graying association could also be relevant for developing ways to delay hair graying.”

The team found additional genes associated with hair including EDAR (ectodysplasin A receptor) for beard thickness and hair shape, PRSS53 (protease serine S1 family member 53) for hair curliness, FOXL2 (forkhead box L2) for eyebrow thickness, and PAX3 (paired box gene 3) for monobrow prevalence.

“The genes we have identified are unlikely to work in isolation to cause graying or straight hair, or thick eyebrows, but have a role to play along with many other factors yet to be identified.”

The findings were published online today in the journal Nature Communications.
WHAT DOES THIS ALL MEAN
Conclusion

We can look at SNP’s associated with aging

• We can evaluate known SNP’s in human populations with known impact on skin
• Currently, a limited number of companies provide and analysis and recommend either products or modalities (anti oxidants, nutritional supplements) that testing indicated would better meet their individual needs.
• A customized product can be developed
• This is a young science, with much more to learn to further optimize treatment modalities
  Epigenetic factors and SNP’s have a synergistic relationship
  More knowledge will continue as research expands
SNP’s and personalized cosmetics

http://dx.doi.org/10.2147/CCID.S55669: Genetic polymorphisms and skin aging: the identification of population genotypic groups holds potential for personalized treatments

Int J Cancer. 2009 August 15; 125(4): 909–917. : Genetic variants in pigmentation genes, pigmentary phenotypes, and risk of skin cancer in Caucasians


The Nrf2-Antioxidant Response Element Signaling Pathway and Its Activation by Oxidative Stress* Published, JBC Papers in Press, January 30, 2009, DOI 10.1074/jbc.R900010200, Truyen Nguyen, Paul Nioi, and Cecil B. Pickett

Interaction between SNPs in the NRF2 gene and elite endurance performance Nir Eynon, Alberto Jorge Alves, Moran Sagiv, Chen Yamin, Michael Sagiv, and Yoav Meckel

The Nrf2-Antioxidant Response Element Signaling Pathway and Its Activation by Oxidative Stress