PEPTIDE'S Function in TREATING ACNE

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Acne vulgaris is a chronic inflammatory condition affecting approximately 85% of adolescents.[1] However, influences such as bacterial overgrowth, decreased cellular communication and increased inflammation must be considered when treating acne. The skin has its own microbiome and relies on a balance between commensal bacteria, fungi and viruses. Understanding the bacterial role in the microbiome is the first step towards successful treatments for many types of acne. Antimicrobial peptides and host-defense peptides provide advanced scientific technology with a significant impact to improve the success rate of treatment outcomes. This article will explore how particular peptides are able to assist the skin's own natural response to combat acne, inflammation and skin barrier imbalances.

UNDERSTANDING ACNE

Acne is a disorder of the pilosebaceous unit which consists of the hair and its follicle, the arrector pili muscles and the sebaceous gland.[2] What causes this disorder? The dead cells (corneocytes, keratinocytes) shed into the hair follicle instead of desquamating to the stratum corneum, causing a buildup and eventually forming a plug. This plug blocks oxygen from entering the pore, creating an anaerobic environment. Bacteria such as Propionibacterium (P. acne) is a common commensal bacterium and thrives in this anaerobic environment. Bacteria then adheres to the sebum promoting colonization and growth. The dead keratinocytes, combined with sebum and other cellular fluids, create a food source for the bacteria as well as creating a protective structure to guard against the immune system.[2]

Antimicrobial peptides disrupt quorum signaling to stop bacteria from multiplying.

CELLULAR COMMUNICATION

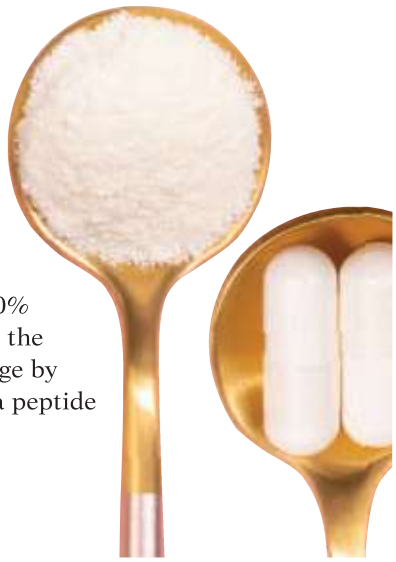
Cellular communication is critical for cell turnover, energy promotion, mitochondrial function, quorum sensing in bacteria and cellular and tissue repair. Cellular communication was once thought to be a one-way street with messages stemming from the DNA. However, it was discovered that the internal cellular communication is multi-directional from the DNA and from the cells to the DNA. As cellular health improves, the DNA's chronological clock is slowed or reversed to an earlier set point, which is reflected in the cells.[3]

PEPTIDE FUNCTIONS

A peptide is a chain of two or more amino acids naturally joined together during the digestive process. Amino acids are the small components of protein. Peptides are key messengers to cells and play many important roles contributing to the proper functioning of cells. One specific peptide role is to disrupt bacterial growth. Specific peptides have antimicrobial-like actions. Other peptides can assist with the repair and reconstruction of skin remodeling after injury or during inflammation.

Keep in mind the various terms for peptides, specifically bio-peptide and bio-active peptides. A bio-peptide is a term used for biologically active compounds that are chemically altered from protein fragments. Pharmaceutical grade or L-forms of amino acids are considered biologically active. Peptides can be of a natural substance or chemically engineered. Bio-active peptides are peptides that complement and assist the normal biological processes of the cell.

Additionally, it is important to note that plant-based peptides are not the same and do not function the same as human peptides. The breakdown is in the sequencing or coding of the peptide. In plant peptides, the sequencing of amino acids may only be 60-70% the same as of the amino acid sequence of a human peptide. The remaining 30% of the amino acid message makes the peptide an unrecognizable message by the human cells. For example, if a peptide



message to a cell states, "cells reproduce," but only 70% of that message was comprehensive, it would send a message something like, "cels eprodu." The letters of the words in the message are 70% identical, but the message is still unrecognizable because 30% is not understood.[3] If the letters of a word were not exact, the word changes, as does the meaning. This results in miscommunication or sometimes, no communication at all to the human cells.

BACTERIAL COMMUNICATION

Bacteria uses a communication system as well. This communication system is called "quorum sensing" or "quorum signaling." This communication is needed to coordinate certain behaviors. Some of these behaviors are biofilm formation (the ability to adhere to an object with a moist environment), reproduction (virulence) or to resist antibiotics. Bacteria uses quorum sensing to signal molecules for communication to grow in strength and number. As this population increases in numbers and strength, it produces density within the cell.[4]

If a quorum is not reached, bacteria will not divide as quickly or cannot defend itself when the body's immune cells respond. Adequate supplies and support must be present in the immediate environment for a higher chance of survival for the bacteria.

ANTIMICROBIAL PEPTIDES

Antimicrobial peptides are a unique class of peptides found to be effective in modulating quorum signaling. The specific function of an antimicrobial peptide is to interfere with the messages of the bacterial colonies. The bacterial colonies communicate to reach a point of saturation or density.

The communication confusion prevents the quorum from being reached and, in turn, prevents bacteria from dividing and multiplying. The bacteria do not have the proper supplies or support present to survive. By interrupting the communication signals, antimicrobial peptides confuse the bacteria. Consequently, the bacteria quorum perceives the environment as hostile because of a lack of necessary quorum signaling from surrounding bacteria. The body's immune responses can ultimately gain the upper hand in fighting the bacteria by destroying it naturally.[3]

A common question is how antimicrobial peptides can specifically target the invading pathogen or destructive bacteria while sparing the commensal or good bacteria. The answer lies in the composition of the electrical change of the cellular membrane between the pathogenic and the commensal bacteria cells.

Let me unpack this concept. The cellular membrane is largely composed of phospholipids. Some phospholipids are positively charged, while others are negatively charged. For example, phosphatidylcholine is normally uncharged, while others, such as phosphatidylserine, is negatively charged. Interestingly, phosphatidylserine is the phospholipid found in bacteria. Bacteria carry many negative charges, increasing the electrostatic interaction. Consequently, the antimicrobial peptides are targeted or drawn to interact with the negatively charged membrane.[5] Antimicrobial peptides are a novel and innovate approach in the treatment of acne.

PEPTIDES AND INFLAMMATION

Inflammation is the common culprit of acne and many skin disorders. It is an important consideration when combating acne breakouts. When toxins, allergens or pathogens emerge, inflammation is the body's first line of defense. The immune system has an arsenal of tools to defend or neutralize the toxemic effect of microbial pathogens. Inflammation is the cell's reaction to call in the first responders. It is a highly coordinated, biochemical sequence of events that begin with the rapid migration of leukocytes, cytokines and other immune cells.[6] Inflammation can be constructive and beneficial; however, chronic inflammation becomes detrimental to the skin. When the cells are continually burdened by toxins or pathogens, the cells send a signal to alarm the immune system.

Host defense peptides are a class of peptides that assist with immune functions of the cells. When cells

are damaged or dying, a unique molecular pattern emerges. This pattern informs the defense peptides to respond. According to a research study, "Expression and Function of Host Defense Peptides," these specific peptides are multifunctional and aim to maintain homeostasis.[6] The message to the cells is the same healing message naturally produced when skin is injured and begins the healing process.

During the healing process, some cells respond with inflammation and others respond by contracting the blood vessels. During the reconstruction phase of healing, collagen is replaced or re-assembled to repair at the injured site. This is a regular occurrence during inflammatory acne sites. Collagen is altered during the scar phase because the cells are patching the proliferation as quickly as possible. Over time, new collagen replaces the temporary collagen. The reconstruction phase can last from several weeks to several years. This is dependent upon the available resources at the time of healing and if the host defense peptides are working optimally.

APPROACHING ACNE

There are many considerations of the skin when working with acne, inflammation and skin repair. Understanding how antimicrobial peptides interfere with bacterial quorum sensing amidst the repair process using host defense peptides, provides a new platform for more natural treatment outcomes. In addition, understanding the function of cells and how peptides fulfill the natural role of cellular communication and microbiome balance provides estheticians, doctors, nurses and naturopathic professionals another tool to treat acne, chronic inflammation and compromised skin barrier conditions.

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