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Antimicrobial Peptides: An Emerging Catagory in Food Industries

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ABSTRACT

Introduction- Antimicrobial peptide as natural peptides is very divergent group of natural protein found in animal, plant, and insects as well as in bacteria. These types of peptides are responsible for enhancing the shelf-life, best alternate of chemical preservatives and work against antibiotic resistant bacteria in food and pharmaceutical industries also best alternate of chemical preservatives, also significant in defence of host pathogenic organisms. Antimicrobial peptides used either alone or along with other essential oils and polymeric nano-particles combination enhancing more activities of peptides. This review presents the different sources of antimicrobial peptides or different type of sources. Hence, it will be widely used in food industries as well as pharmaceutical industries.

Keywords
Antimicrobial peptides, Bio-preservation, Antibiotics

INTRODUCTION

Food industries nowadays depend on chemicals for the preservation of food stuff for increasing shelf life. Chemical preservatives eg: sulphur dioxide, nitrites or Benzoate found many harmful effects on public health and also on nutritional value of many food stuffs. Due to the traditional preservation practices, the safety and standard quality of food stuff is inadequate for the consumers, because of the excess use of chemical preservatives; bacteria have developed more resistant from antibiotics (Saeedetal, 2009). So, there is a much needed to find out a new natural peptides for preservative for preservation. The considerable beneficial effect of using antimicrobial peptides is that it preserves the food without changing its quality as well as efficiency (Wang *et al*., 2016), also the problem is Considering as food-spoilage, food products can be preserved by using microbes and their antimicrobial products as bio-preservatives, which improve the shelf-life of food and enhance the food safety (Song *et al.*, 2015). Fermentation is very defining example of food biopreservation and lactic acid bacteria (LAB) is most important bacteria that involves in the fermentation process produce organic acids, other metabolites and antimicrobial protein known as antimicrobial peptides (Abdelbasset*et al*., 2018).
LAB has been used as natural bio preservative nowadays for many foods, because of the production of hydrogen peroxide, organic acid and peptides, which inhibit the growth of gram positive and gram negative microorganism. United States Food and Drug Administration (USFDA) approved LAB as a safe for the preservation of fermented food (Upendra*et al*., 2016).

Various sources of antimicrobial peptides (AMPs)

AMPs are oligopeptides are formed from number from 5-100 of amino acids. These peptides occurring in both eukaryotes eg.Plants and animals (Bagley, 2014; Berglund *et al.*, 2015) and prokaryotes eg.Bacteria (Conlon, 2010).

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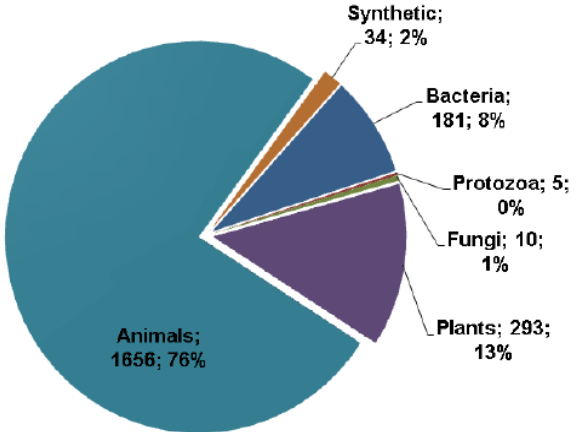
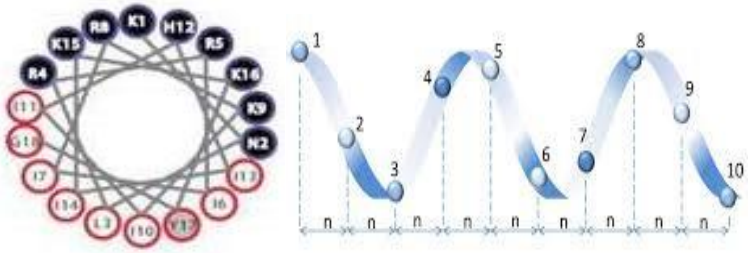


Fig1: Database sources of antimicrobial peptides (www.google.co.in)

Structural View of AMPs

Most AMPs characterized as following four types based on their secondary structures: β-sheet, α-helix, extended, and loop. Among these four α-helix and β-sheet structural groups or most studied AMPs to date is α-helix structures the distance and angle between two adjacent amino acids is around 0.15 nm and 100° from the top view. Protegrin, magainin, cyclic indolicin, and coiled indolicin are some best examples of Amps. β-sheet peptides are composed of at least two β-strands with disulfide bonds between these strands.



(A) **(B)**

Fig 2: Structural view of α-helical Amp. (a) Top view of helical wheel like projection of the Amp. (b) Peptide side view (Bahar and Ren., 2013)

1. **Eukaryotic peptides**

a) AMPs from plants source

Plant amps are made up of 2-9k dalton in molecular weight and also cystiene rich. It derived from different plant parts such as leaves, pods, flower or seeds. Theses exhibits broad defence antibacterial spectrum against *L. monocytogenes, L. ivanovii*and*E.coli* therefore, can be used as a food biopreservative in many food stuffs. For eg., defensins, cyclotides, thionins (types I–V), 2S albumin-like proteins and lipid transfer proteins along with knottin peptides, impatiens, puroindolines, vicilin like, glycine-rich, shepherins, heveins or snakins used as plant derived amps (Hintz *et al*., 2015).

b) AMPs from animal Source

Amps obtained from amphibians, mammals and fish etc. These peptides secreated in the peanth cells and mucosal epithelial cells. As the example protamine and pleurocidine are 2 type of amps derived from fish that could be used as food preservation. chitison and magainins is widely used in the food industries nowadays. Chitison is commonly can be found in exoskeleton of

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crustaceans such as crabs or lobster. Chitison used for enhancing shelf life of fruits because of reduce water vapour content and prevent from transmission of oxygen through edible coating and film of chitions as well as maganins derived from amphibians show broad antimicrobial activity against gram positive and gram negative bacteria commonly used for the preservation of meat and cheese. Amps from eukaryotes further divided into two types:

- Cationic Peptides
- Anionic Peptides

- **Cationic Peptides**

Till now a 1000 of cationic peptides they knew as cationic antimicrobial peptides (CAPs) because it exhibit positive charges.

a) Cathelicidins

In mammals mostly cathelicidins is found as cationic peptides A total 30 cathelicidins reported from mammals till date where, cathelicidins (LL-37) present in human known for activity against bacteria, fungi and virus (Olyinloye et al., 2015).

b) Histone derived peptides

Histone derived peptides are antibacterial peptide showing antimicrobial activity without interrupting the microbial cell wall. Parasin and buforin are two histone derived peptides from amphibians these peptides are highly against fungi and bacteria (Oyinloye et al., 2015).

c) Defensins

Defensins are also cationic peptides act as antibacterial, antifunagal and antiviral activity, highly rich in cystine, derived from plant, mammals and insects.

- **Anionic Peptides**

Most of the anionic peptides having broad antimicrobial against gram positive and gram negative bacteria. They are very small in size having 721.6 to 823.8Da in molecular weight (Cruz *et al*., 2014). Maximin-H5 and Dermcidin are two examples of anionic peptides isolated from human sweat, rich in gluatamic acid and aspartic acid.

2. Prokaryotic Peptides

a) AMPs from microorganisms

Amps derived from the bacteria known as prokaryoteic peptides. As examples of prokaryotic peptides are hilobiotics, colicin, lintobiotics and microcin (Bagley, 2014). Some few examples of antimicrobial peptide derived from microorganisms are Pediocin, Nisin and Plantaricin etc. They are widely used in food industries as bio-preservative.

Mechanism action of various Amps

Amps generally disrupting the cell membrane integrity via interaction with negatively charged cell membrane by inhibiting the function of DNA and RNA and protein synthesis. All cationic amps known at late-90s. However, the concept that AMPs need to be cationic was changed later with the discovery of negatively charged AMPs in 1997. For example maximin-H5 and dermicidin derived from frog skin and sweat gland tissues of human both are anionic peptides. Generally an AMP is only effective against one class of microorganisms e.g., bacteria or fungi. However, there are exceptions and some AMPs are known to have different modes of action against different types of microorganisms. Bacteria, fungi and viruses are killed by indoclicidin. It exhibits antifungal activities by distrupting cell membrane and inhibiting DNA synthesis. In

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comparison, some AMPs have the same mode of killing of different cell types. However some of them can kill both fungi and parasites by forming pores in their cell membranes example PMAP-23. Therefore, AMPs rapid killing effect does not only come from membrane disruption but can also come from inhibition of these functional proteins.

CONCLUSION AND FUTURE PERSPECTIVES

Biological preservation of food products and antibiotics in industries is eco-friendly and very effective method used nowadays. Only nisin, as peptide is internationally approved for safe food preservation but so many data is available online showing the effect of many antimicrobial peptides against many food borne pathogens also so many sources to isolate peptide either its prokaryotes or eukaryotes which is very helpful in human health through enhancement of food shelf life biologically as well as its works against many bacteria so it also work against many antibiotic resistant bacteria and excessive use of antibiotics which is also complicate human health lifestyle. Moreover there is a need to understand the quality and efficacy of existing antimicrobial peptides, or to increase the efficiency of antimicrobial peptide by fusing of two peptides so the effect of peptide against pathogens will be enhanced. The newly database regarding this as in case of naturally occurring peptides we can insert or remove the unavailable amino acid it can be added through chemically and it will be very helpful for enhance the quality and efficiency of peptide. It will also helpful for the problems occurring in microbial resistance to antibiotic if it will be used in combination with antibiotics. Antimicrobial peptides encouraging improving the quality of public lifestyle as natural or chemical free for food as preservation as well as reduce the risk of antibiotic resistant bacteria.

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