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REVIEW

Oral antimicrobial peptides: Types and role in the oral cavity

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Abstract Antimicrobial peptides (AMPs) are a wide-ranging class of host-defense molecules that act early to contest against microbial invasion and challenge. These are small cationic peptides that play an important in the development of innate immunity. In the oral cavity, the AMPs are produced by the salivary glands and the oral epithelium and serve defensive purposes. The aim of this review was to discuss the types and functions of oral AMPs and their role in combating microorganisms and infections in the oral cavity.

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1. Introduction

All living organisms have defense systems for combating microorganisms and potential pathogens (Zasloff, 2002; Dale et al., 2006; Martin et al., 2015). In the higher vertebrates, prior to the evolution of adaptive immunity, a more simpler and nonspecific system of innate immunity evolved and still continues to play a role as the principal defense system for almost all living organisms (Adonogianaki et al., 1993, 1996; Aguilera et al., 1998). The innate immunity modulates its antimicrobial functionality by small cationic peptides with activity against gram-positive and negative bacteria, parasites, fungi and some viruses (Akalin et al., 1993; Allaker et al., 1999; Allgrove et al., 2008). The mechanism of action against microbes and pathogens is principally attributed to the disruption of the microbial cell membrane (van't Hof et al., 2001; Shai, 2002). However, complete understanding of the exact process or processes is deficient and it is plausible that other mechanisms are at play which are yet to be identified (Quinones-Mateu et al., 2003; Sinha et al., 2003; Wang et al., 2004; Yasin et al., 2004; Gordon et al., 2005a,b).

The innate immune system augments the physical and chemical barriers e.g. skin and mucous membranes by producing antimicrobial peptides (AMPs) (Hancock and Sahl, 2006). AMPs have a widespread distribution in human body and have antimicrobial activity against microorganisms (Zasloff, 2002; Gordon et al., 2005a,b). All AMPs are extracted from larger precursors and comprise of a signal sequence with post-translational modification that includes glycosylation (Sewald and Jakubke, 2002), proteolysis (Vos et al., 1995), amino-acids isomerization, carboxy-terminal amidation and halogenation (Bulet et al., 1993). To date around 106 Human host defense peptides have been identified (Wang, 2014). AMPs are found in oral saliva, in the epithelium and in neutrophils (Dale et al., 2006). AMPs are classified in different classes according to amino acid composition, size and conformational structures (Table 1) (Hancock and Lehrer, 1998; Brogden, 2005; Harris et al., 2009).

The oral cavity has a very unique environment and microorganisms and pathogens have easy access to it and the rest of the body through epithelium and the gastrointestinal tract (Dale and Fredericks, 2005). Despite the high microbial load of the oral cavity that can potentially be disease forming, abrasions, cuts and minor surgical procedures rarely lead to infection. This indicates the highly effective host-defense mechanisms that exist and are active (Zasloff, 2002). Oral epithelial cells, salivary glands and neutrophils secrete at least forty-five identifiable antimicrobial gene products that are found in saliva. Saliva acts as a potent line of defense owing to its antibacterial, antioxidant and antifungal properties along with the oral mucosa, which plays a role as an important barrier (Amerongen and Veerman, 2002; Yoshio et al., 2004). The most common AMPs that express in the oral cavity are listed in Table 2. Subsets of these AMPs are also expressed in the crevicular fluid and are more concentrated than in saliva (Alves and Olivia Pereira, 2014; Ashby et al., 2014). In addition to their role played as antimicrobials, AMPs also serve as effective biological molecules in immune activation, inflammation and wound healing (Yang et al., 2002; Koczulla and Bals, 2003; Yang et al., 2004) and are being extensively researched upon for clinical applications (Koczulla and Bals, 2003; Dale et al., 2006; Meyer and Harder, 2007; Kang et al., 2014; Vale et al., 2014).

Table 1 Representation of antimicrobial peptides classification on different basis.

Classes	Comments
Anionic peptides	They are small, rich in glutamic acids and aspartic acids, present in human, cattle and sheep
Linear cationic α-helical peptides	They are short of cysteine and short peptides. e.g. LL37 from human
Cationic peptides enriched for specific amino acids	They are proline rich peptides e.g. abaecin from honeybees
Anionic and cationic peptides (contain cysteine and disulfide bonds)	They contain cysteines with one or more disulfide bonds e.g. protegrin from pigs, tachyplesins from horse crabs and α–β-defensins from humans, cattle, mice and pigs
Anionic and cationic peptides fragments of larger proteins	They are similar to other AMPs but their role in innate immunity is not yet clear. e.g. lactoferricin from Lactoferrin and casocidin-I from human casein