



PHYSIOLOGICAL PERSPECTIVE OF SALIVA ACT AS A WOUND HEALING

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ABSTRACT

The oral cavity is a moist environment; a film of fluid called saliva constantly coats its inner surfaces and occupies the space between the lining of oral mucosa and teeth. Saliva is a complex fluid, produced by the salivary gland, whose important role is maintaining the wellbeing of mouth. According to *Ayurveda* immune system and such all other protective mechanisms in the body have been grouped under '*Kapha*'. *Vagbhata* named all five subtypes of '*Kapha*' for the first time. *Bodhaka Kapha* is said to be present in oral cavity and helps in the perception of taste and some protective functions. Regulating the wound healing response and microbiota, saliva is thought to contribute to the almost scar-free healing in the oral cavity. The wound healing properties of saliva was already acknowledged by the ancient Greeks 2,000 years ago when they applied snake saliva to open wounds to enhance cutaneous wound healing.

KEYWORDS: Oral cavity, Saliva, salivary gland, Immune System, *Bodhaka kapha*, microbiota.

INTRODUCTION

Theory of '*Tridosha*' is unique to Ayurveda. The term '*Dosa*' in Samskrit means 'the disturbing factor'. Basically three '*Doshas*- '*Vata*', '*Pitta*' and '*Kapha*'- are said to be responsible for maintenance of homeostasis in the body; and health is nothing but a state of equilibrium among these three *Doshas* results in disease.^[1] These *Dosha* also determine the psycho-physiological constitution of an individual. *Dosha* are able of vitiating the different bodily tissues, when deviating from the state of equilibrium and can lead to diseases. *Kapha dosha* are heavy, dense, cold, soft, unctuous, sweet, immobile and slimy in their property.

Immune system and such all other protective mechanisms in the body have been grouped under '*Kapha*' in Ayurveda.^[2] *Bodhaka Kapha* is one of the five *sub-doshas* (sub-types) of *Kapha dosha*. *Sub-doshas* are responsible for overseeing specific actions, organs or emotions, and relative imbalance in these energetic sub-categories tends to be the root cause of illness, disease and ill-health. *Bodhaka Kapha* is said to be present in oral cavity and helps in the perception of taste. Root of the tongue is the site of '*Bodhaka Kapha*'. Tonsils are the important lymphoid tissue- containing structures present there.^[3] Although *Bodhaka Kapha* is located in the mouth, it is also connected to the parietal lobe of the brain, which processes tastes. *Bodhaka Kapha*, therefore, operates not only on a physical level, but on the level of consciousness and intelligence as well. The functions of *Bodhaka Kapha* can be compared as per modern medical science is Saliva. Salivary juice secreted in the oral

cavity not only helps in the process of taste perception but also performs some protective functions. Human saliva contains a number of physical, physiochemical and chemical agents that protect oral tissues against noxious compounds, in particular those produced by various microorganisms. The association of salivary antibody (total IgA, IgG, and IgM and antibodies reactive with *Streptococcus mutans*) and non-antibody (lysozyme) and buffers to neutralize bacterial acids that promotes dental decay.^[4] In the saliva Lysozyme and Immunoglobulins combat invading microbes.^[5] According to a 2019 National Center for Biotechnology Information (NCBI) study, Human saliva stimulates skin and oral wound healing in vitro, human saliva can stimulate oral and skin wound closure and inflammatory response. Saliva is therefore a potential novel therapeutic for treating open skin wounds, it stated. "Saliva contains growth factors of active peptides like histatins, mucins, cathelicidins and its anti-microbial and anti-inflammatory properties. Early morning saliva can heal acne in healthy individuals. Scientifically, the pH of saliva is different. Saliva has a pH between 6.0 and 7.0.^[6] In any infection, the pH becomes acidic and saliva is alkaline. So, it will obviously balance the pH.

A wound is a type of injury which happens relatively quickly in which skin is torn, cut, or punctured (an open wound), or where blunt force trauma causes a contusion (a closed wound). In pathology, it specifically refers to a sharp injury which damages the epidermis of the skin. Saliva contains a large number of proteins with a role in wound healing. Saliva contains growth factors of active

peptides like histatins, mucins, cathelicidins and its anti-microbial and anti-inflammatory properties. It contains growth factors, especially Epidermal Growth factor, which promotes the proliferation of epithelial cells. Trefoil factor 3 and histatin promote the process of wound closure. The importance of Secretory Leucocyte Protease Inhibitor is demonstrated by the fact that in the absence of this salivary protein, oral wound healing is considerably delayed.

DISCUSSION

A wound is a break or opening in the skin. Skin protects our body from germs. When the skin is broken, even during surgery, germs can enter and cause infection. Wounds often occur because of an accident or injury^[7]. Wound healing involves four overlapping phases (hemostasis, inflammation, proliferation, and tissue remodeling). Hemostasis occurs directly after injury and results in vasoconstriction and activation of platelets, which secrete many soluble wound healing factors to activate the coagulation pathway leading to the deposition of a fibrin clot. At the onset of trauma, inflammatory cytokines are released for the recruitment of different cell types. Monocytes and macrophages infiltrate the wounded area to combat infection and remove the damaged tissue. Upon wounding, it is most essential that the skin barrier function is restored as quickly as possible. Re-epithelialization of a wound involves keratinocyte proliferation, migration, and differentiation in order to restore the breached epithelial barrier. In the underlying connective tissue, fibroblasts proliferate and migrate into the wound bed and deposit new extracellular matrix, which remodels into scar tissue.

Saliva contains several proteins which play a role in the different stages of wound healing. Saliva contains substantial amounts of tissue factor, which dramatically accelerates blood clotting. Subsequently, epidermal growth factor in saliva promotes the proliferation of epithelial cells. Secretory leucocyte protease inhibitor inhibits the tissue-degrading activity of enzymes like elastase and trypsin. Salivary histatins in vitro promote wound closure by enhancing cell spreading and cell migration, but do not stimulate cell proliferation^[12]. Saliva contains 99.5 percent water and other anti-microbial properties. When applied, it kills the unknown bacteria and keeps skin hydrated. It also has anti-inflammatory functions that stop skin inflammation. The salivary juice contains an array of enzymes such as lactoferrin, peroxidase, lysozyme, cystatins, and defensins. It also contains a plethora of antibodies such as thrombospondin, IgA, and leukocyte that eradicate the breakout causing germs. Saliva also contains nitrate that decomposes to form nitric oxide and opposes the microbial growth on skin. It also neutralizes the acidic content and balances the pH of skin. On the other hand, the contents of the saliva such as hyaluronan, lysophosphatidic acid, and other enzyme proteins boost the formation of new cells and heal the

tissues. It contains cell-derived tissue factor, and many compounds that are antibacterial or promote healing. Salivary tissue factor, associated with microvesicles shed from cells in the mouth, promotes wound healing through the extrinsic blood coagulation cascade. The enzymes lysozyme of saliva kills some bacteria such as Staphylococcus, Streptococcus and Brucella. Peroxidase, defensins, cystatins are all antibacterial. Lactoferrin has antimicrobial property.^[8] Immunoglobulin IgA also has antibacterial and antiviral actions.^[9] Thrombospondin and some other components are antiviral. A protease inhibitor, secretory leukocyte protease inhibitor, is present in saliva and is both antibacterial and antiviral, and a promoter of wound healing. Saliva contains growth factors such as epidermal growth factor, lysophosphatidic acid, hyaluronan and NGF, which all promote healing. In humans, histatins may play a larger role. Saliva also contains an analgesic, opiorphin.^[11]

Saliva contains a vast cocktail of proteins (>1,000 proteins) which function in synergy so that saliva is mitogenic, enhances cell migration, and also acts in an anti-microbial manner resulting in a healthy oral microflora. For example, defensins, histatins, and mucins protect against the formation of a pathogenic microbiome; whereas cytokines, chemokines, and growth factors directly enhance wound closure. Saliva also stimulates the innate immune system, and therefore, the inflammatory phase of wound healing by stimulating fibroblasts. By regulating the wound healing response and microbiota, saliva is thought to contribute to the almost scar-free healing in the oral cavity. The wound healing properties of saliva was already acknowledged by the ancient Greeks 2,000 years ago when they applied snake saliva to open wounds to enhance cutaneous wound healing.^[10]

Histatins act through a multistep mechanism, in which the histatin is internalized by *C. albicans* after binding by cell wall Ssa proteins and targeted to energized mitochondria. The killing of *C. albicans* is accompanied by the release of intracellular potassium ions, and the TRK1 potassium channel is critical. Histatins inhibit respiration and induce the formation of reactive oxygen species in *C. albicans* cells and induce an osmotic stress response. Histatin 5 (Hst 5) is a salivary cationic histidine-rich peptide produced only in humans and higher primates. It has high antifungal activity against *Candida albicans* through an energy-dependent, non-lytic process; but its bactericidal effects are less known. We found Hst 5 has bactericidal activity.

Lactoperoxidase (LP), hydrogen peroxide (H₂O₂) and thiocyanate ion (SCN⁻) form a bacteriostatic system in human saliva. The oral lactic-acid bacteria release H₂O₂ as a by-product of carbohydrate metabolism. Stimulated leukocytes in the salivary glands, oral mucosa, and saliva may also produce H₂O₂ and secrete peroxidase enzymes. Peroxidases catalyze the oxidation of salivary

thiocyanate (SCN⁻) by H₂O₂ to yield hypothiocyanine ion (OSCN⁻), which is in acid-base equilibrium with hypothiocyanous acid (HOSCN). HOSCN oxidizes essential sulfhydryl groups of bacterial enzymes and transport systems, resulting in inhibition of metabolism and growth.

How to apply saliva?

Use early morning secretion before even drinking water. During the whole night, the saliva secretion is lowered which is why the juice is purest at this stage. The high-acidic nature of morning saliva kills the microbes and disinfects the skin. Leave the application there for 20 minutes to accelerate the immunity of skin. The infection might become worse as saliva contains a lot of bacteria too. You can apply it when the breakouts are in their primary stage. Saliva applies on blemishes and dark circles also.

CONCLUSION

Histatins stimulated wound closure of (primary) cells of both oral and non-oral origin. This suggests that the cellular receptor of histatins is widely expressed and not confined to cells derived from the oral cavity. These findings encourage the future therapeutic application of histatins in the treatment of all kinds of wounds.

The pH of saliva is different. In any infection, the pH becomes acidic and saliva is alkaline. So, it will obviously balance the pH. During the last few years, it has been shown that Understanding these salivary proteins opens the way for the development of new wound healing medications.

This research may offer hope to people suffering from chronic wounds related to diabetes and other disorders, as well as traumatic injuries and burns. In addition, because the compounds can be mass produced, they have the potential to become as common as antibiotic creams and rubbing alcohol.

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