The influence of peat water to the colony number of aerob bacteria in mouth

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Peni Purwandari,^{1*} Nurdiana Dewi,² Lia Y. Budiarti³

Abstract

Objective: The purpose of this study was to determine the effect of peat water to the number of aerobic bacterial colonies of the oral cavity. This study used the quasi-experimental research design with pre–posttest control group design. The study sample consisted of 20 students of Faculty of Dentistry, Lambung Mangkurat University, Banjarmasin.

Material and Methods: The research used peat water after mouth rinsing with 10 ml of water and then the number of aerobic

bacterial colonies which were present in bacterial growth media was counted.

Results: This study showed that the result of paired t-test showed no significant differences between the groups before and after rinsing with peat water ($p=0.001$) ($p<0.005$).

Conclusion: Based on the research we conclude that the peat water may cause an increase in the number of colonies of aerobic bacteria of the oral cavity.

Keywords: Aerobic bacteria of the oral cavity, The number of colonies, Peat water

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^{1,3}Department of Microbiology, Faculty of Dentistry, University of Lambung Mangkurat, Banjarmasin, Indonesia

²Department of Oral Biology, Faculty of Dentistry, University of Lambung Mangkurat, Banjarmasin, Indonesia

Introduction

Majority of turf area in Indonesia are found in four huge islands, which are 35% in Sumatera, 32% in Kalimantan, 30% in Papua and 3% in Sulawesi. Approximately three-quarter area in South Kalimantan is located less than 100 m above the sea level, so that approximately 8000 km² is swamp. It turns out the water condition in South Kalimantan turf to be swamp.¹

South Kalimantan Province has good water such as river and swamp.² Swamp water is called as turf water by local communities has organic material aggregate that comprises of wooden materials or mosses which occurred because the speed of accumulation is higher than the decomposition.³ There are many turf water surfaces found in turf area and lowland, mainly in Sumatera and Kalimantan, in South Kalimantan, turf water is consumed for daily needs such as for taking bath, brushing tooth or washing clothes.

The characteristic of Turf water characteristic are high color intensity (brownish red), low pH, high content of organic material, turbidity and the low content of suspended particle and low cation,⁴ the low pH in turf water can induce tooth damages such as dissolving tooth enamel so that the tooth becomes porous quickly and causes demineralization as well as erosion in the tooth.^{3,5}

Mouth cavity contents various colonies of bacteria. These microflorae are normally found on the surface of mouth cavity. Bacteria accumulate not only in the soft tissue but also in solid layer that are

called as plaque. Plaque is a slight layer, sticky and colorless. It consists of bacteria colonization sticking at tooth and gums surface.⁶ Aerobic bacteria serving in mouth cavity consist of streptococcus, staphylococcus, corynebacteria and anaerobic bacteria such as lactobacillus.⁷ Streptococcus is cariogenic bacteria because they are capable of produce acid from carbohydrate which can be fermented. The bacteria can grow up in sour circumstance and stick on tooth surface because their capability of establishing the polysaccharides extract from the cell which is very sticky from food carbohydrate. The polysaccharides consist of glucose polymer and form a matrix of tooth plaque to a gelatin consistency. As a result, aiding other bacteria to stick on the tooth as well as reciprocal adhering with one another and because the plaque turns out to be thicker so that it will obstruct the saliva function in neutralizing the plaque.⁶

One of the factors influencing the bacterial growth is ecology circumstance of mouth cavity, such as pH. Streptococcus mutans (*S. mutans*) can grow optimal in circumstance with pH 4.5–7. It is because *S. mutans* has acidogenic characteristic that tolerates against sour condition and produces acid.⁸ Acidity of turf water also influences the bacterial growth in mouth cavity. In pH about 6–6.5, all kinds of acidogenic bacteria can form acid, however streptococcus has the highest activity which still can produce the acid upto pH 4.5. It is because *S. mutans* has aciduric characteristic, the

*Correspondence to:

Peni Purwandari, Department of Microbiology, Faculty of Dentistry, University of Lambung Mangkurat, Banjarmasin, Indonesia
penipurwandari@yahoo.com

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more aciduric more is the capability of bacteria to produce acid continuously and faster the cell division the more and the longer acid is produced.⁸ The acidity of turf water influence the quantity of aerobic bacteria colonies in mouth cavity, because of the pH of turf water is low (<6.5) so that it makes the bacteria to perform acidogenic and aciduric characteristics. Based on these considerations, researcher would like to observe whether the turf water can escalate the quantity of aerobic bacterial colonies in mouth cavity.⁸

Material and Methods

This research is quasi experimental one with pre-posttest with control group design. This research observed the influence of turf water against the quantity of aerobic bacterial colonies in mouth cavity. The obtained samples used purposive sampling method. Sample total was 20 peoples with two times of treatment (before and after). The sample total in this research was determined by the use of Federer formula. The sample taking is conducted by the inclusion and exclusion criteria.

This research was started by taking the data, the subjects were instructed not to brush their teeth and eat or drink for 1 hour before the treatment. After taking initial data, the subjects were provided with the instruction regarding the treatment to gargle with aquadest and turf water. The gargle duration is 30 seconds. Twenty students of Faculty of Dentistry, Lambung Mangkurat University, Banjarmasin that fulfilled the inclusion criteria who previously gargle with 15 ml of sterile aquadest for 30 seconds. Then the samples were placed in sectional sterile tube and after that 1 ml was taken and mixed with sterile aquadest in reaction tube until we obtained 10 time dilutions. Dilution products were taken as many as 250 μ l and they were streaked above nutrient agar plate. After that, they were incubated at 37°C for 24 hours. Next, we conducted calculation of the bacteria colonies quantity in mouth cavity by using colony counter and the result served as the control before the treatment. After that, each student gargled with 15 ml turf water for 30 seconds according to the requirement. The residue of the samples was thrown away. Every sample from each treatment group after finished gargling with test treatment gargle again with 15 ml of sterile aquadest for 30 seconds. The samples were placed in sectional sterile tube and 1 ml was taken to be mixed with sterile aquadest until we obtained 10 time dilutions. About 250 beta-dilution products were taken and they were trimmed above nutrient agar plate. And then, they

cavity by administering the colony counter. The research protocol was approved by the ethical committee of Faculty of Medicine, Lambung Mangkurat University, Banjarmasin.

Results

Based on the research conducted, we obtain average quantity of aerobic bacterial colonies in mouth cavity before and after gargling with turf water.

Figure 1 reveals that there is average quantity escalation of aerobic bacterial colonies before and after gargling with aquadest and turf water. Data analysis was started from Shapiro–Wilk normality test. The result obtained from normality test is 0.422 ($p>0.050$) in significance to the value in pre-test group and 0.059 ($p>0.050$) in post-test group, therefore we can recognize that the datum distribution in two groups is normal. Next, to recognize whether there is significant difference in each treatment, we conducted paired t-test by administering 95% level of confidence. Based on the paired t-test result, we obtain t-value that is -18.122 with 0.000 ($p<0.05$) significant (2-tailed), it means that there is significant difference between the average of aerobic bacteria in mouth cavity before and after gargling with turf water.

Figure 1 The average quantity of aerobic bacteria colonies in mouth cavity before and after gargling with turf water

Discussion

In the result of colony quantity calculation of aerobic bacteria after gargling with turf water, we obtain that the bacteria colony quantity runs into escalation because of the acidic characteristic of turf water that displayed a pH of 7 which was less. The acidity or pH condition which indirectly decreases can support the bacteria and fungi growth, when it is continuously exposed and it can escalate the colony quantity of aerobic bacteria in mouth cavity.⁹

Bacteria which are the flora in mouth are potential to affect caries by resulting acid products which

are capable of demineralizing tooth enamel. The food remains in mouth cavity will be processed by bacteria that can produce acid, the acid thus formed will patch on the enamel surface and then it will induces the demineralization leading to the escalation of bacteria and tooth caries.¹⁰

The component of enamel are mineral, dentin and cementum is hydroxyapatite (HA) which is composed of $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$. The reciprocation of mineral ion between tooth surface and oral biofilm always occurs every time when eating and drinking. In normal condition, hydroxyapatite is placed in balanced condition with saliva which is saturated by Ca^{2+} and PO_4^{3-} ion. Hydroxyapatite will be reactive against hydrogen ion or <5.5 of pH which is critical pH for HA. In that critical pH condition, the H^+ ion will react with PO_4^{3-} ion in saliva. This process will change PO_4^{3-} into HPO_4^{2-} . The HPO_4^{2-} which is formed will interrupt the normal balance between HA and saliva, so that the HA crystal in the tooth will be dissolved, this process is called demineralization.¹¹ The mechanism of the escalating of bacteria colony continue until caries have relationship with the demineralization and remineralization process. Plaque on tooth surface consists of bacteria that produce acid as a result of their metabolism. The acid dissolve the calcium phosphate mineral on tooth enamel or dentin in the process called demineralization.¹² Acidity of a solution is avowed with pH, it is called neutral solution when the pH value is 7, acid solution when the pH value is <7 and alkali solution when the pH value is >7 . The acidity of a solution is important and qualitative estimation of electrolyte in saliva is important to determine the pH.¹³

Normally, bacteria in the mouth cavity are formed where the saliva serves as the regulating factor of acid and alkali circumstance in mouth which determines up and down pH.⁹ The carbohydrate metabolism result due to the bacteria in mouth cavity that produces acid which encourages the process of enamel and dentin demineralization. The pH descent of saliva can escalate the tooth caries frequency. Saliva acidity (pH) in lower level is optimal for bacteria to grow up, bacteria will grow up well.⁵ The increase of bacterial quantity is directly proportional with the saliva pH descent because of the characteristic of the bacteria that can produce acid and grow up well in acid circumstance. The bacteria can produce acid (aciduric) and live in acid circumstance (acidogenic) so that they have the potency to form acid extensively. The bacteria bear the acid final product, and it will escalate the mouth cavity pH so that it causes the enamel demineralization. When it occurs continuously, it will affect the increase of bacteria colony quantity, dentin declassification and accelerate tooth caries.¹⁴

Statistically obtains the significant relationship between saliva pH and the increase of bacteria colony quantity. Plaque bacteria will ferment sucrose and produce organic acid with low pH. Acid circumstance will affect enamel damage, 95% of them are hydroxyapatite and cause bacterial accumulation, demineralization and caries. Bacteria will fermented carbohydrate and produce acid, the low saliva acidity (pH) is evidently optimum circumstance for bacteria growth, the bacteria can grow up well so that it causes the pH descent up to 4.5–5.0 pH in 1–3 minutes. In the 30–60 minutes, pH will be back to be normal approximately 7 and if the pH descent continuously occurs, it causes the increase of bacteria accumulation for 24 hours on tooth surface.¹⁵

Exposed isotonic beverage is the same as exposed turf water which has the same acidity. The turf water influence which has acid characteristic will affect the mouth cavity circumstance.¹⁶ The previous research reveals that the 4.5 pH value is the critical pH which makes enamel run into demineralization process.¹⁶ Moreover, the mineral content of hydroxyapatite calcium is also dissolved in that pH (9.17). It occurs because the greater the buffer capacity of beverage or food, the longer the period is required to neutralize the acid. The high buffer capacity of a beverage will escalate the dissolution because more ions of tooth minerals required to make the acid inactive in advanced to demineralization process,¹⁸ so that when exposed to the turf water with pH <7 , it induces the mouth pH to diminish long-drawn. After the bacteria is exposed to carbohydrate and low saliva pH because of the acidic turf water acid, extracellular polysaccharide bacteria will be formed.

The optimal acidity of saliva for the growth of extracellular polysaccharide bacteria is approximately 6.5–7.5 and the mouth cavity with pH 4.5–5.5 will facilitate the acidogenic bacteria growth such as *S. mutans*.¹⁹ One of the important virulent factors of *S. mutans* is acidophilic. The metabolism of *S. mutans* escalates in very low pH, whereas the metabolism of other bacteria in plaque will be sluggish when they are place in acid circumstance. The matter of making the metabolism of *S. mutans* to escalate in low pH is proton-motive force administered to transport nutrition which penetrate the cell wall with low pH, regulated by hydrogen ion content which escalates in acid circumstance.²⁰ *S. mutans* is able to diminish or maintain the mouth cavity acidity in acid circumstance making this condition profitable for its metabolism and not profitable for other species that live at the same time.

S. mutans is acidogenic bacteria that can produce acid, more often they produce acid, resulting more

colonies of plaque bacteria.⁸ The turf water acidity is one of factors affecting the bacteria growth in mouth cavity. In pH 6–6.5, all kinds of acidogenic bacteria will form acid, however those that have the high activity is streptococcus that still produces acid until pH 4.5. It occurs because *S. mutans* has aciduric characteristic, the more aciduric the more higher the bacterial activity to produce acid continuously and the faster the cell division the more and longer acid is produced. Therefore, the turf water acidity influence the quantity of aerobic bacteria colonies in mouth cavity.⁸

Conclusion

In this research, we obtain the significant differences ($p < 0.05$) between quantity increase of aerobic bacterial colony in mouth cavity before and after gargling with turf water, therefore we arrived at the conclusion that turf water escalates the aerobic bacterial quantity in mouth cavity. As a suggestion, we do not consume turf water because it has high acidity so that it may escalate the colony quantity of aerobic bacteria in mouth cavity, we should consume clean water such as aquadest, Perusahaan Daerah Air Minum (PDAM) water or well water which have normal pH. Advanced research is required by sampling the inhabitants around anjir village in administering turf water for daily need, identification of other bacteria in mouth cavity if there is increase of bacteria colony quantity in mouth cavity or not, identification of mouth cavity fungus against turf water if there is increase of fungal quantity in mouth cavity or not and administering the other culture matters other than saliva, for example by using buccal mucosa wipe, throat wipe or tongue scraping in order to be a comparison matter.

Conflict of Interest

The authors report no conflict of interest.

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