Application and Investigation of Total Adenylate(ATP,ADP,AMP)Hygiene Tests for Oral Health Monitoring

ABSTRACT

Oral hygiene maintenance is important to prevent oral diseases, such as dental caries, periodontal diseases, and mucosal inflammation associated with oral microorganisms. Although many oral inspection methods have been developed, a monitoring system that is convenient, less expensive, less time-consuming, portable, and precise in evaluation is required. Recently, a novel caries risk protocol, commercially known as CariScreen (CS, Oral Biotechnologies), has been developed. This tool detects adenosine triphosphate (ATP) in organisms through a luciferase-mediated luminescence reaction. ATP is an indispensable energy source in all organisms, including microorganisms in the oral cavity. However, it has been reported that CS is not useful for caries risk assessment in children.

In addition, another ATP detection tool, the LuciPac A3 Sanitation System (A3, Kikkoman Biochemifa Company), is already being used in the food industry. It detects ATP as well as its degradation products, including adenosine diphosphate (ADP) and adenosine monophosphate (AMP). Therefore, LuciPac A3 is expected to have a higher sensitivity than CS. In this study, I aimed to investigate the total adenosine nucleotides (ATP, ADP, and AMP) hygiene tests using microorganism cultures and oral specimens.

Examination using an ATP standard solution and *Streptococcus mutans* as a microbial sample showed that LuciPac A3 exhibited higher relative light unit (RLU) values than CS. A3 also showed a substantial value in the supernatant from the bacterial suspension and detected the RLU value even in heat-killed bacteria, whereas CS couldn't detect the RLU value in the supernatant and few the RLU value in heat-killed bacteria. Moreover, in comparison to CS, A3 detected representative microorganisms, including *Staphylococcus aureus* (primary bacterium of normal microflora), *Streptococcus mutans* (cariogenic bacterium), *Candida albicans* (etiological agent of opportunistic candidiasis), *Porphyromonas gingivalis* (periodontopathic

bacterium), and *Prevotella intermedia* (periodontopathic bacterium) with high sensitivity in both planktonic and biofilm conditions. These results indicate that LuciPac A3 can detect oral microorganisms with higher sensitivity than CS.

They showed an excellent correlation among the RLU value of CS and A3, and with oral bacterial numbers although A3 showed higher sensitivity than CS. This result strongly indicates that these devices, especially A3, are useful for detect oral hygiene cleanness. Furthermore, these devices were used to detect the bacteria present in saliva samples, and their RLU values decreased after using a mouthwash, suggesting that oral hygiene could be detected using saliva samples. However, the device values did not correlate with the bacterial count in the saliva sample, possibly due to contamination of ATP from the host tissues. Further improvements are necessary for monitoring saliva specimens.

This study suggests that A3 is a useful tooth surface cleanness for detection tool in clinical dentistry, for conducting oral hygiene tests with high sensitivity to detect the oral hygiene status, although CS may still be useful for this purpose.