Task Force III: Conclusions and Recommendations: Biochemistry and Microbiology

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There is no doubt that fluoride occurs in duct saliva and that the levels can be increased by systemic dosage. However, we do not know the concentrations of fluoride in saliva from the minor salivary glands, and whether the levels found there exceed those in plasma. Furthermore, we are uncertain of the concentration of fluoride in the gingival fluid. Information on both these points could explain, in part at least, the high levels of fluoride found in cervical enamel.

It was generally agreed that the continued presence of low levels of fluoride in the mouth is a desirable goal and that research directed toward this end should be actively encouraged. The development of devices and materials capable of releasing low levels of fluoride continuously either systemically or locally seems a reasonable approach.

All the available evidence shows that fluoride in enamel affects its surface properties. Because the type of surface influences the composition of pellicle, it is considered desirable that the pellicle formed on teeth in high and low fluoride areas should be studied and, if suitable techniques could be developed, the ability of pellicle to concentrate fluoride should be determined. At the

same time, the colonization of the tooth surface by microorganisms should be investigated. The influence of fluoride compounds used in topical applications such as SnF₂ and amine F should be similarly determined. Such a study would also afford the opportunity to determine whether fluoride confers protection by sealing the enamel pores.

It was also discussed whether the presence of plaque is essential to promote the uptake of fluoride by enamel on erupted teeth. There is some equivocal evidence which seems to indicate that this indeed is the situation. It is considered that an answer could be achieved through the use of gnoto-biotic animals fed an appropriate diet.

Attention was also directed to the distribution and forms of fluoride in plaque. Exciting developments have occurred in the area recently and it is now agreed that fluoride is bound in plaque. However, we need to know the fluoride concentration in plaque allowed to accumulate in different areas of the mouth for varying periods of time, under well-controlled conditions. These investigations should be carried out in both young and old subjects. At the same time we should determine the levels of calcium and phosphorus in plaque, and investi-

Bowen

327

gate whether the phosphorus is organic or inorganic. The physical state of the calcium phosphate in plaque should also be identified.

It is imperative to determine where the fluoride is bound in plaque. For example, how much is bound to amorphous calcium phosphate, to microorganisms, to plaque matrix, and in plaque fluid.

There is clear evidence that some plaque microorganisms are capable of binding fluoride; the species and strains of bacteria which have this capacity should be identified. The site in the cell where the binding occurs should be determined, and whether the uptake is energy dependent should be established. It was agreed unanimously that ^{18}F and fresh isolates should be used in such studies. The effect of fluoride on the growth rate and metabolism of individual strains should be determined under strictly controlled growth conditions. The influence of fluoride on microorganisms cultivated at varying growth rates, different pH values and substrate limitations could be determined. Such studies would clearly include an investigation into extracellular and intra-cellular polysaccharide. Attempts should be made to isolate pH-independent fluoride-resistant mutants to determine their metabolic pathways.

It is also necessary to determine the effect of fluoride on the bacterial population of plaque to ascertain whether exposure to fluoride gives rise to a population which is resistant to the effects of fluoride. It is recognized that this is a difficult task, but one approach might be to use media containing three-carbon, carbohydrate substrates.

There was considerable discussion on the influence of fluoride on the metabolism within dental plaque. It was agreed that the ability of plaque to lower the pH value of sugar solutions should be followed, longitudinally if possible, in populations following the introduction of water fluoridation or mouth rinsing programs, and that particular attention be paid to the metabolic end-products. Such an approach may provide an explanation, in part, for the action of fluoride and at the same time provide an insight on whether the bacterial population of plaque is being altered.

An alternative approach could be made utilizing specialized groups of patients who are highly caries-active; for example, those who suffer from xerostomia. The influence of fluoride on their plaque metabolism could be studied in depth using a variety of approaches.

If one area were to be selected for special emphasis the uptake of fluoride by microorganisms and its effect on the metabolism of microorganisms grown under a variety of controlled conditions should receive priority.