

ROYAL INSTITUTE OF TECHNOLOGY
Division of Agriculture
Stockholm 70
Sweden

Dental caries from the nutritional point of view.¹

By *Alfred Åslander*

Introduction.

In Sweden dental caries is omnipresent. In 1942 only one individual per 1 000 was found to be free from dental caries among young men starting their compulsory military training, and in the school-year 1957—1958 only 40 school children in Stockholm were found to have caries-free teeth among 52 352 treated in the school clinics. Thus practically 100 per cent of the population suffer from dental caries.

In the summer of 1938 the writer was forced to ponder deeply on the problem of dental caries. My wife was then going to have our first baby, and I was determined that that child should *not* suffer from dental caries. But in that case some drastic preventive measures would have to be taken.

The writer himself grew up on a dairy farm in north Sweden and as a child suffered badly from toothache, which at that time, more than 50 years ago, appeared to be regarded merely as a small inconvenience for children, just as measles and mumps are today. For a highly strung boy it was a gruesome experience not to be shared by my children.

¹ A short introduction to the writer's theory of a complete tooth nutrition as a means of preventing dental caries in children. The article was intended for the VIII ORCA Congress in London 4th—7th July 1961 but it was, unfortunately, written too late for that purpose.

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The working hypothesis.

From the writer's point of view dental caries in children appeared to be most probably a result of insufficient nutrition. Common food is too poor in nutrients essential for the formation of strong and healthy teeth. I grew up on a farm and the food was mostly home-produced, and even according to present-day demands the daily fare must be considered to have been a sufficient one as far as common nutrients are concerned. However, my investigations of the soils on the parental farm had shown them to be very poor in phosphates, and thus the home-produced food was also probably poor in phosphate. The bulk of the teeth is made up of phosphates. My poor teeth could be a result of phosphate starvation. Hence, my child born in the late summer of 1938 was given small daily doses of CaHPO_4 . The teeth grew white and strong. After two years the phosphate was replaced by bone meal. During these two years the writer was engaged in extensive nutritional experiments with rabbits, guinea pigs and rats, which brought out some new aspects of nutritional problems. Bone meal appeared to provide more suitable nutrition for the teeth than phosphate. In addition to its bulk of phosphates, bone meal contains a good many other elements, some or all of which may be essential tooth nutrients. For human beings, who are by nature omnivorous, the eating of bones appeared to me to be quite natural.

Results.

The experiment on tooth nutrition with my children as human guinea pigs started in 1938. After 10 years of experiments the results appeared to be such that they deserved to be made known. My children, then three in number, were free from dental caries, while their playmates, living under similar conditions but not given bone meal, suffered badly from that disease. Apparently it is possible to prevent dental caries in children by a suitable form of tooth nutrition, Aslander (1948). Later on, a good many children have been reported free from dental caries as a result of the writer's bone-meal method.

The reliability of current theories.

Acid fermentation. This time-honoured theory of the cause of dental caries had already been advanced in 1890. At that time it was not possible to measure the degree of acidity, and even later on, when it became possible to determine the lowering of the pH by the acid fermentation on or around the teeth, the very slight change in actual H-ion concentration brought about by the acid fermentation does not seem to have been duly appreciated. A well-known Stephan's curve shows that — owing to acid fermentation — the pH level will reach about pH 4.8 — and that only for a short period. That is a very moderate degree of acidity, not possible to detect by our sense of taste. Many foods are much more acid. For instance, an apple is about 20 times as acid and oranges are around 100 times as acid. If the slight and temporary acidity brought about by acid fermentation should be able to cause dental caries in strong and healthy teeth, then the eating of apples and oranges and other really acid foods would be suicidal for the teeth. And it seems highly improbable that Nature should have provided us with a sense of taste that finds very pleasant an acidity that in reality is suicidal for the teeth. The acid fermentation theory must be regarded as a product of the panic caused by the discovery of bacteria combined with the lack of technical means of determining the degree of acidity. The theory was a brilliant one at the time; by now it has become out-of-date.

The proteolysis-chelation theory. This theory has been put forward in recent years. It ascribes dental caries to the activity of micro-organisms that attack the organic compounds of the enamel-forming chelates, that is, compounds consisting of a metal ion, in this case primarily Ca, and a complex organic part. The bacteria require an alkaline reaction, that is to say, the normal reaction in the mouth, and the conditions will thus be unfavourable for the bacteria only during the brief periods when the reaction around the teeth becomes acid owing to the eating of acid foods or the fermentation of carbohydrates. The proteolysis-chelation theory is an attempt to apply modern developments in chemistry as an explanation of dental decay, but the theory cannot be a valid one. If the agents producing

proteolysis-chelation were able to attack strong and healthy teeth, there would not be a tooth left in either Man or beast. The bacteria have ideal working conditions day and night all the year round. They must be able to attack only under specific conditions.

The nutrition theory. A tooth is a living and independent individual. It grows out of the mandible in about the same way as a plant grows out of the soil. The root of a plant anchors the plant in the soil and takes up a considerable number of mineral plant nutrients from the soil solution. At present we know at least 12 such essential plant nutrients, all of which must be taken up in sufficient quantities if the plant is to grow normally. If any one of them is lacking or present in too small amounts, then the plant will develop a deficiency disease. Thus the vigour and health of the plant is wholly dependent upon a sufficient supply of *all* the nutrients needed. Likewise, the root of a tooth anchors the tooth in the mandible and takes up from the blood stream several essential minerals, of which at least six are known at present, and the vigour and health of the tooth is wholly dependent upon a sufficiency of *all* the nutrients needed. If one or more of the essential mineral nutrients are lacking or present in the blood stream in insufficient amounts then the structure of the tooth will be of poor quality, such as cannot endure the normal strains to which a tooth is subjected. Dental caries will inevitably appear. Thus, dental caries will attack only teeth that are undernourished, not teeth that have received complete tooth nutrition. Dental caries is a deficiency disease.

Verifications of the nutrition theory.

The nutrition theory of dental caries explains all the known facts of the disease. A few are listed below.

1. Our forefathers had far better teeth than the present generation. For instance, the writer's parents, born around 100 years ago, had as children perfect teeth. Thus their tooth nutrition must have been faultless. In fact, they were bone-eaters. In those days the small Baltic herring was grilled crisp and eaten with head and tail, bones and all. Moreover, it was eaten at least once daily. By the time the

writer was born these somewhat crude table manners had been abandoned. Only the flesh of the fish was eaten. The mineral nutrition of the teeth became deficient. As a consequence children had very poor teeth.

2. The cariogenic properties of sugar and other carbohydrates are due not to their fermentation into lactic acid but to their lack of minerals essential for tooth nutrition. White sugar is almost entirely deprived of all the healthy minerals of sugar cane or sugar beet. The same applies to a great extent to white wheatflour. The greater the proportion of these and other mineral-poor foodstuffs in the daily fare, the more the teeth will be starved of minerals, the poorer will be the structure of the teeth and the more rapidly will dental caries appear.

From the point of view of tooth nutrition it would be convenient to condemn sugar and cereals and to recommend mineral-rich foods such as fruit and vegetables, preferably eaten raw so that all of the minerals are obtained, but the problem is not quite so simple. Sugar and cereals are inexpensive foods, and for that reason popular among housewives. On the other hand, fruit and vegetables are, over large areas and especially during the winter, rather expensive foods. It is more helpful to most people to recommend a mineral-food supplement such as bone meal, especially the brand of bone meal which the writer has been using, improved by the manufacturer with the addition of small amounts of salts of iron, iodine and cobalt. In the writer's household sugar and cereals probably make up a greater part of the daily fare than the average, but the children's teeth are perfect owing to the daily dose of improved bone meal. Thus, it seems possible to combine an inexpensive daily fare with complete tooth nutrition.

3. The effect of fluorine on dental health has been elucidated. From the nutritional point of view fluorine is one of several essential tooth nutrients. Accordingly, the addition of fluorine to the nutritional supply can bring about complete tooth nutrition only provided that fluorine is the one single tooth nutrient lacking. If other tooth nutrients besides fluorine are lacking, then with the addition of

fluorine — according to the common laws of nutrition — only a partial improvement in dental health can be achieved. Moreover, if the fluorine supply is excessive compared with the supply of other mineral tooth nutrients, then we have an unbalanced nutrition which will impair the teeth. As far as the writer is aware, no case has been reported in which fluoridation of the water supply has resulted in the total elimination of dental caries. Evidently fluorine has nowhere been the sole tooth nutrient lacking. In many cases, however, fluoridation has to some extent improved dental health, showing that fluorine has been one of the nutrients lacking. In many cases harmful results from fluoridation have been reported, apparently in cases where an unbalanced nutrition has been brought about by the fluoridation. At best, fluoridation is a partial nutrition that can lead to a partial improvement of dental health. Fluoridation was proposed at a time when it was assumed that fluorine was the only element lacking for the establishment of dental health. At present we know that at least six elements — and probably more — are essential tooth nutrients. Thus the very foundation on which fluoridation is based has been destroyed. What we need is not partial nutrition with fluorine, which at best makes only a partial improvement; what we need is a complete form of tooth nutrition that will produce teeth that are highly resistant or even immune to dental caries. The addition of improved bone meal to a common daily fare seems to provide complete tooth nutrition and give perfect teeth.

Conclusions.

Dental caries is a deficiency disease. Our modern food is too poor in essential tooth nutrients, especially mineral nutrients. As a result the structure of the teeth will be of such a poor quality that it cannot endure the normal strains to which it is subjected. The structure will collapse, dental caries will set in. By complete tooth nutrition it is possible to grow teeth that are highly resistant or immune to dental caries. Improved bone meal appears to be a reliable food supplement. It provides a large number of minerals, all or many of which are essential tooth nutrients. Tooth nutrition ought to be studied extensively. Our knowledge of mineral nutrition is meagre

in the case of Man. In order to obtain some data the writer as far back as in 1948 proposed an investigation using as subjects 1 000 pregnant women and the ensuing children up to the age of at least 10 years. It is the writer's conviction that the prevention of dental caries should begin in the mother's womb and not in the dentist's chair. Several forms of tooth nutrition should be tested. Among other things, bone meal is repulsive to some persons. For that reason a purely inorganic mixture of suitable minerals should be tested. And many other things. To date, no funds have been available for such an investigation. The idea of complete tooth nutrition seems to be too modern. That is unfortunate for the children. When the complete nutrition theory has been sufficiently tested and the method universally adopted, then dental caries is practically bound to disappear, just as other deficiency diseases, such as scurvy and goitre, have practically disappeared.

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