Weekly variation in the acidogenic response of plaque

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The fall in plaque pH after sucrose rinsing was monitored once a week for 9 (8) weeks in succession, to measure the weekly variation in the magnitude of pH drop in the same subject. The plaque pH was measured with a touch electrode placed interdentally between the first and second premolar. The subject rinsed his mouth with 10% (w/v) sucrose solution, and the plaque pH was thereafter monitored for 40 min. The minimum plaque pH (pHmin), the change between starting and minimum pH (ΔpH), and the resting pH value were determined. The pH values of the maxilla and mandible differed. No difference was seen between the right and left sides. As a rule, intraindividual variation was lower in terms of pHmin values than in terms of ΔpH values. It was concluded that pH assessment with the touch electrode appeared to show a small weekly variation intraindividually and to be sensitive enough to test the acidogenic potential of foods, but only in the maxilla. □ *Cariology; dental plaque; pH measurements; sucrose rinses; touch electrode*

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There are three main methods for monitoring pH changes in plaque: plaque sampling and in vitro pH measurement (1) and in vivo monitoring of plaque pH with a touch electrode (2) or with an indwelling electrode (3). Schachtele & Jensen (4) have shown that there are no major differences in sensitivity among the three methods.

The fall in pH in human dental plaque can be used to obtain estimates of the acidogenic potential of different foods. In this evaluation it is necessary to find subjects who display substantial acidogenic responses when presented with fermentable substrates. Several studies of the connection between the pH drop and the age of the plaque have shown that up to the 5th day the resting pH and the minimum pH obtained after sucrose rinsing tend to decrease, and the pH area (= pH × time) of the plaque tends to increase (5–7).

For relevant pH assessments the test subjects should show pH drops with sucrose rinses below pH 5. In food test panels in which the same subjects appear regularly the weekly variation in the pH drop is an important factor. Consequently, the aim of the present study was to examine the weekly variation in the acidogenic potential of interdental plaque by using a touch electrode in four subjects. The acidogenic responses of the maxilla and mandible were also compared.

Materials and methods

The subjects consisted of four persons, three women and one man, aged 24, 25, 25, and 50 years, their DMFS indexes being 20, 13, 0, and 43, respectively. They were all highly infected with *Streptococcus mutans* (CFU in saliva $>10^6$/ml), and in a preliminary screening a sucrose rinse (10 ml, 10% w/v, 1 min) caused an acidogenic response with a minimum plaque pH (pHmin) <5.7. The criteria of subject selection proposed by Harper et al. (8) and Edgar & Geddes (9) were thus met.

The subjects refrained from all oral hygiene for 48 h before the test session, and they were not allowed to eat or drink for at least 2 h beforehand. All test sessions were scheduled to take place at the same time of the day for each subject. The test was performed once a week during 9 sequential weeks.

The plaque pH monitoring was performed

Table 1. The means and standard deviations of the subsequent tests for the values of resting pH, pHmin, and ΔpH in the four quadrants of the subjects. The number of subsequent measurements is given in parentheses

Subject	Upper right	Upper left	Lower left	Lower right
1 (8)				
Resting pH	6.98 ± 0.34	6.89 ± 0.46	7.18 ± 0.42	7.06 ± 0.40
pHmin	5.25 ± 0.76	5.14 ± 0.61	5.80 ± 0.53	5.64 ± 0.59
ΔpH	1.69 ± 0.52	2.00 ± 0.44	1.30 ± 0.33	1.51 ± 0.37
2 (9)				
Resting pH	7.06 ± 0.47	7.03 ± 0.49	7.32 ± 0.53	7.26 ± 0.51
pHmin	5.00 ± 0.44	4.93 ± 0.21	5.84 ± 0.50	5.83 ± 0.52
ΔpH	1.97 ± 0.65	2.04 ± 0.46	1.37 ± 0.43	1.48 ± 0.60
3 (9)				
Resting pH	6.52 ± 0.34	6.45 ± 0.32	6.96 ± 0.30	6.91 ± 0.27
pHmin	4.69 ± 0.21	4.73 ± 0.22	5.53 ± 0.22	5.57 ± 0.41
ΔpH	1.76 ± 0.46	1.79 ± 0.31	1.56 ± 0.48	1.46 ± 0.67
4 (9)				
Resting pH	6.62 ± 0.51	6.60 ± 0.47	7.09 ± 0.54	7.00 ± 0.51
pHmin	5.01 ± 0.31	5.26 ± 0.34	5.63 ± 0.32	5.50 ± 0.46
ΔpH	1.52 ± 0.44	1.46 ± 0.52	1.40 ± 0.52	1.39 ± 0.77

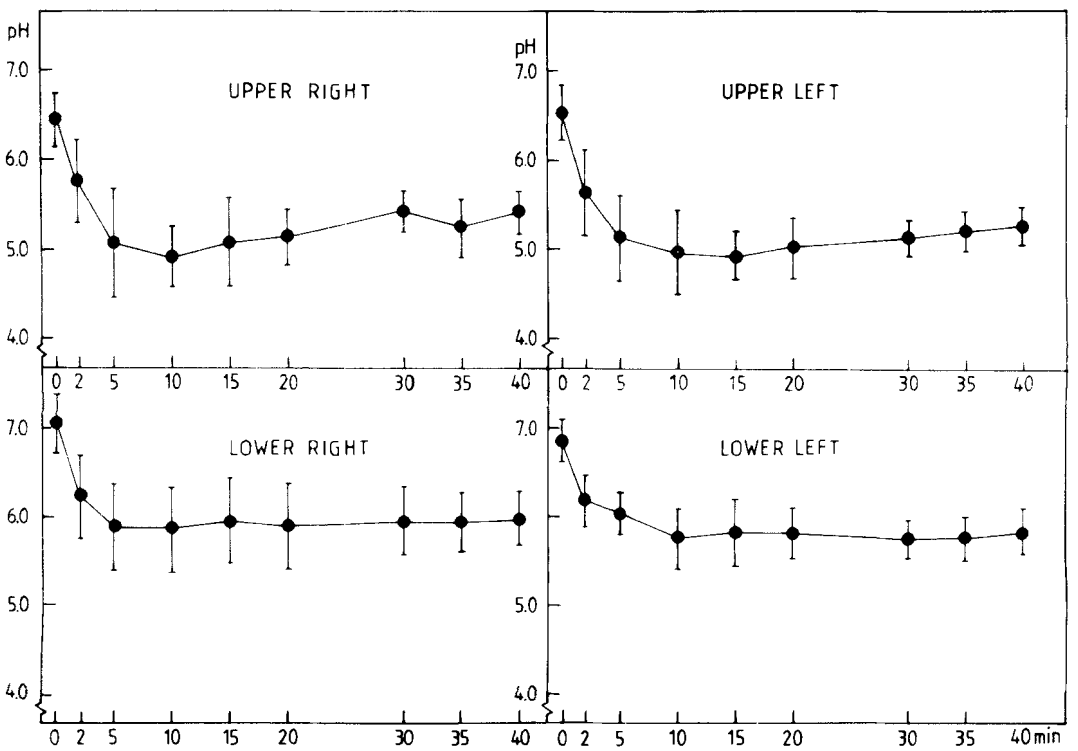

Fig. 1. The acidogenic response of Subject 3 to sucrose (10 ml, 10% w/v, 1 min). The means and standard deviations of nine subsequent weekly measurements are given.

at approximal sites between the first and second premolar or between the canine and first premolar in each quadrant, using a palladium touch electrode (Beetrode MEPH-3L; W-P Instruments, Inc., New Haven, Conn., USA). The electrode was connected to an Orion Research Model 701 A millivolt meter (Orion Research Inc., Cambridge, Mass., USA). The touch electrode consisted of a metal–metal oxide wire loop, 0.1 mm in diameter and 2 mm long, mounted in a tapered base. The hand-held electrode was inserted into the interdental space just apical to the contact point. The subjects did not have any restorations in these teeth. During the measurement procedures the subjects were seated in a dental chair.

The sequence of the procedures was as follows: The measurements were first made in 'resting plaque'. The second measurement was done after 2 min of paraffin chewing, which was performed to increase the plaque pH (starting pH). Thereafter the subjects rinsed their mouth for 1 min with 10 ml 10% (w/v) sucrose solution. The plaque pH was determined 2, 5, 10, 15, 20, 30, 35, and 40 min after the rinsing.

The electrode was calibrated at the start of the test and after every plaque pH determination, using pH 4.0 and 7.0 buffers. The millivolt readings were converted to pH values by means of standard curves.

The pHmin and the difference between starting pH and minimum pH (ΔpH) were measured. The measurements were performed eight times in subject 1 and nine times in subjects 2, 3, and 4.

Results

The weekly variation ($n = 8$ or 9) in the resting pH, pHmin, and pH values of the four subjects is given in Table 1. For all subjects the pHmin and pH values were similar in the right and left sides of the maxilla and mandible. The acidogenic response was, however, higher in the maxilla than in the mandible. Fig. 1 shows the means and standard deviations of the mean pH values of the nine tests in the four quadrants after sucrose rinsing in Subject 3.

There were no decreasing or increasing trends in the pHmin values in the weekly measurements for any of the subjects (Fig. 2). The variation in the pHmin values was highest in Subject 1. As a rule, the magnitude of the acidogenic response remained fairly constant throughout the 8- to 9-week period.

Discussion

We chose the Beetrode electrode for the plaque pH measurements since with this method we could simultaneously monitor the plaque pH at four quadrants of the mouth over time. Furthermore, with this method the pH can be measured in plaque accumulated in vivo. The loop of the electrode is also thin enough to reach the approximal space, and this electrode is easy to use, quick-responding, and cheap. The pHmin was reached within 10 min for all subjects and within 5 min for Subject 2. It is obvious that the amount (age) of plaque has an influ-

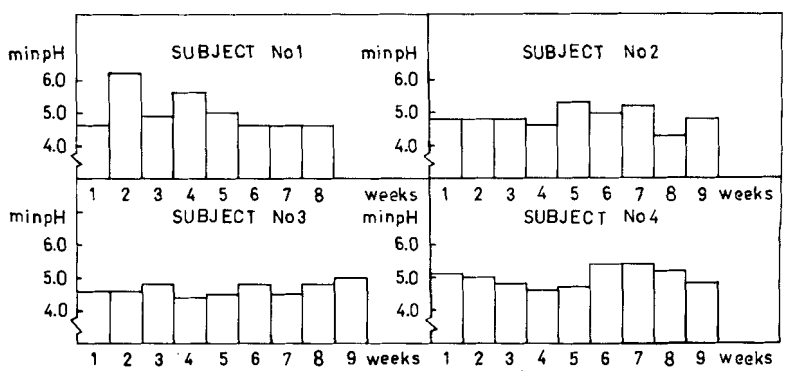

Fig. 2. Weekly variation in pHmin values measured in the upper right quadrant.

ence on the time taken to reach the pHmin (10). In this study the plaque was only 2 days old, and therefore the plaque pH decrease was fast.

The deviations in plaque pH values for each subject are in agreement with the results of Edgar (11). The variations were highest for Subject 1, who also showed the highest pH decreases. The standard deviations of the pHmin values were lower than the standard deviations of the ΔpH values, as was also found by Jensen et al. (5). The pHmin values thus appeared to be more repeatable than the ΔpH values, even though these variables should be interrelated.

The difference in the pH responses between the maxilla and mandible has been demonstrated previously by Kleinberg et al. (12). This study also showed a higher pH response in the maxilla. The higher the pH drop, the more sensitive the pH assessment will be; in other words, hypoacidogenic products would show low acid production when measured in the maxilla but not in the mandible. It was concluded that the present pH measurement using the touch electrode appeared to show a small weekly variation intraindividually and function with a satisfactory sensitivity, comparable to, for example, telemetry, but only in the maxilla.

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