INHIBITION OF PLAQUE ACIDOGENESIS IN SITU BY TOPICAL APPLICATION OF SODIUM FLUORIDE

By

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Introduction

There are two major theories dealing with the mechanism whereby the fluoride ion aids in reducing the incidence of caries. One theory states that the fluoride ion reacts chemically with the inorganic material of the tooth enamel, rendering it less soluble in acid solutions. The second theory deals with the action of the fluoride ion upon the oral microflora rather than on the tooth itself, and states that the fluoride ion affects the acid-producing organisms in such a way that less acid is produced. Although the major effect of fluoride appears to be related to its reaction with the inorganic material of the tooth, the ability of fluoride to reduce acid production in the plaque may be of significance in reducing decay.

This study of the second theory was undertaken to evaluate the following parameters relating to the effect of fluoride on the acid production of dental plaque: 1) the ability of dental plaque to produce acid in response to a sugar rinse; and 2) the alteration of this ability to produce acid after topical fluoride has been applied. As a part of this study it was proposed to compare the resting state and the sugar-stimulated electropotentials existing through the plaque (that is, from the tooth surface to the saliva-plaque interface) and the alteration of these potentials after the application of topical fluoride. This proposal was based on the findings of Parker and Snyder (1) who demonstrated the existence of such a potential gradient. Unfortunately, an insufficient number of patients and a lack of standardization of the techniques involved precluded the inclusion of the data in this study.

Fluoride Inhibition of Acidogenesis

Fluoride has long been known to inhibit certain enzyme reactions. As early as 1934 Lohmann and Meyerhoff (2) demonstrated that enolase, which catalyzes the conversion of 2-phosphoglyceric acid to 2-phosphoenol-pyruvic acid, is the most sensitive enzyme in the glycolytic chain to the action of fluoride ions. Warburg and Christian (3) isolated the enzyme and found that magnesium was required for its maximum activity. It was postulated that the fluoride ion formed a complex with the magnesium and phosphate present, which inhibited the enzyme's catalytic properties.(4) Other enzymes are also known to be sensitive to fluoride (4), but it remains to be demonstrated which enzymes are actually involved in fluoride inhibition of acidogenesis in vivo.

Bibby and Van Kesteren (5) found that as little as 1 ppm of fluoride was sufficient to inhibit acid formation in vitro. Lilianthal (6) challenged this finding and reported that at least 19 ppm were required. Jenkins (7) demonstrated an inhibitory effect at about 6 ppm when the pH of the mixture was 5.0 or below. He also showed increasing inhibition of acid production by a constant concentration of fluoride as the pH was lowered. The concentration of fluoride in saliva is about 0.1 ppm (8), while the recommended level of fluoride in drinking water is only 1.0 ppm. Both concentrations are far too small to inhibit acidogenesis directly. Zwemer (9) suggested that surface enamel could serve as the fluoride source; however, Leach (10) argued that fluoride was too firmly bound to the enamel to be useful in inhibition of acidogenesis. Therefore, attention has been primarily directed to the dental plaque as the fluoride reservoir.

Hardwick and Leach (11) found that pooled plaque samples from thirty individuals had a mean fluoride concentration of 34.2 ppm with a standard deviation of 16.9 and a range of 9.3 to 93.8 ppm. These individuals were selected on the basis of heavy plaque being present in the mouth. Another group of 51 subjects selected at random showed a mean concentration of 66.9 ppm with a standard deviation of 45.7 and a range of 6.4 to 179 ppm. Kudahl (12) made use of the adsorption-isotope-dilution method for determining fluoride concentration, and obtained values ranging from 0 to above 20 ppm. He stated, "These measurements have shown that plaque sometimes contains fluoride at a level where it may inhibit the metabolic systems of oral micro-organisms, but the plaques which were analyzed came from people who live in a low fluoride area, so a further requirement of the anti-enzymatic theory of the action of fluoride is that still higher concentrations of fluoride be found in some or all plaques in a high fluoride area." Recently, Dawes, Jenkins, Hardwick and Leach (13) studied plaque fluoride concentrations in correlation with the concentrations of fluoride in the drinking water. They reported that "... the mean fluoride concentration of plaque collected from eleven-year-old school children living in North Shields (low fluoride) and West Hartlepool (F=2 ppm) was found to be 26 and 47 ppm respectively, the difference being statistically significant ($P < 0.001$)."

The forms in which the fluoride is present in plaque have not been determined. Hardwick (14) suggested that the fluoride was present in an immobile form at pH 7, but was released in ionic form at about 5.4. Ferguson and Jenkins (15) reported a study in 1965 in which they found that the fluoride in the plaque was indeed released in a soluble form when it was washed with equal volumes of saliva at pH 8.5 and 5.0. Thus it would seem from these studies that there is sufficient fluoride present in the dental plaque to inhibit acidogenesis. Furthermore, the fluoride is apparently available in increasing amounts as the pH is lowered. The variability of available fluoride in the plaques of individuals residing in fluoridated areas could help explain the variability of fluoride's caries preventive activity.

Russell (16) suggested that the inhibitory effect of fluoride persisted as long as exposure remained constant, but the effect slowly diminished after fluoride exposure was discontinued. He further theorized that continuous renewal of the fluoride content of tooth enamel was required for maintenance of the maximum caries-inhibitory effect. It is possible that part of this inhibitory effect is exerted through the plaque-fluoride concentration, which also must be periodically replenished in order to maintain levels inhibitory to acidogenesis.

Steiger, et al (17) reported a study in 1962 dealing with the effect of stannous fluoride on the inhibition of acidogenesis *in vivo*. Their study made use of a modified sugar rinse and Kleinberg's antimony electrode.(18) They employed thirteen five-year-old children with moderate to extensive caries experience. They determined the ability of the plaque to produce acid by measuring the pH values before and after sucrose application. This was followed by a prophylaxis on all thirteen children and a stannous fluoride treatment to seven of the children. Re-evaluation of the ability of the plaques to produce acid after one-week and one-month intervals indicated that there was less acid response to sucrose in both groups of children, those receiving prophylaxis only and those receiving prophylaxis plus stannous fluoride. The differences were significant after both the one-week and the one-month intervals, but the investigators were unable to determine whether the change was due to the fluoride treatment, the prophylaxis or a combination of both.

METHODS AND MATERIALS

Assembly for measuring pH: The antimony electrode and potassium chloride bridge used in this study were constructed according to Kleinberg's description.(18) The antimony used in the construction of the electrode was obtained from Fisher Scientific Company, Fair Lawn, New Jersey, and was certified 99.8% pure. The antimony electrode was attached to a Corning model 7 pH meter with an impedance of over 10^{12} ohms. The potassium chloride bridge was connected to a calomel reference electrode which was supplied with the pH meter.

The antimony electrode-pH meter assembly was standardized against three buffer systems in the following manner: Each buffer solution pH was measured three times using the glass electrode supplied with the meter. The average of the three readings was considered to be the pH of the solution. The meter was recalibrated before each solution was tested, using an appropriate standard buffer at pH 7 or pH 4. The glass electrode was then exchanged for the antimony electrode, and at least five readings were made with each solution. The readings were taken from the negative millivolt scale. The average of the five or more readings was used in computing a regression line.

The first buffer system used was the pHydrion system. These buffers were purchased from Van Waters and Rogers, Inc., Portland, Oregon, and were of unknown composition. Table A shows the computation of the regression line using this buffer system. Figure A shows the line between pH 4.2 and 6.5. It will be noted that a slight deviation from linearity occurs for values above 6.5. Other investigators have observed such a deviation, and Kleinberg (18) found it necessary to use a correction factor for values above 6.7. The observed deviations below 4.2 are attributed to a change in buffer composition.

It was felt that a buffer system of known composition should be used; and, therefore, a series of buffers was made according to Kolthoff.(19) The standardization procedure described above was employed. The findings are illustrated in Table B and Figure A. A third system was also used, being made according to MacIlvaine (20), and the findings are illustrated in Table C and Figure A. Varying amounts of sodium lactate were then added to the MacIlvaine buffers to determine whether or not the presence of lactate would affect the millivoltage readings. No appreciable difference was noted. The formula for the regression line obtained from the citrate-phosphate-lactate buffers was used for the final standardization of the electrode.

Sugar rinse solution. Several sugar solutions of varying concentrations were tested in an attempt to find one which would lead to low, stable, reproducible pH readings. Kleinberg (21) found that the maximum pH drop occurred when a 5% glucose solution was used. Higher concentrations did not lower the pH further. Furthermore, she reported an inhibitory effect on acid production when concentrations of above 50% were employed. Based upon these findings, all of the solutions tested in this experiment varied in concentration between 5% and 50%. The weaker solutions of glucose and sucrose tended to give a rapid pH drop with wide deviations from the mean on different days. On the other hand, somewhat more consistent results were obtained by using a "type 50 invert sugar" obtained from a sugar refinery in Portland.[1] This combination sugar is used chiefly by soft drink companies and bakeries. It is a syrup consisting of 77% sugar, being 25% glucose, 25% fructose and 50% sucrose by dry weight. In syrup form, the pH is between 5.0 and 5.5. Before use in this study, the sugar was diluted to approximately 25% sugar concentration and adjusted to pH 6.8 using 1.0 N NaOH. The syrup had an additional advantage of having a prolonged shelf life and requiring less time for mixing than the crystalline forms.

Experiment

Subjects. Seventy-eight girls ranging in age from 13 to 17 years were selected for this study. All were residents of the Louise Home for Girls in Portland, Oregon, where their daily routine was subject to considerable adult supervision.

Initial Examination. The mouth of each girl was examined. X-ray films were taken, and the decayed, missing, and filled teeth were charted. Each girl was instructed to refrain from eating and from brushing her teeth on the mornings of her appointments. They were questioned to determine their previous exposure to topical fluorides, and it was found that about one-third of the girls were using fluoride tooth paste. These girls were instructed to change their dentifrice for the experimental period, which was postponed for at least one month to minimize the effects of extraneous fluoride in the study. Those who had received fluoride treatments from a dentist within three years of the study were not used.

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[1] The name of the company will be supplied upon request.

Pre-fluoride determinations. Each girl was seen three times over a period of two weeks, and on each occasion the following procedures were carried out: The E.M.F. millivoltages of the embrasure plaques of the maxillary molars, bicuspids and cuspids were measured with the antimony electrode. This was done systematically to insure that the same area of each plaque was measured each time. The subject was then given a cup of sugar solution and was instructed to rinse her mouth each minute for a period of ten to fifteen minutes. Initially the sugar solution was applied topically to the teeth, which had been isolated by cotton rolls, but this procedure soon became too tedious for both subject and operator, so the procedure was abandoned. No appreciable differences were noted between the results of the two methods. After the sugar rinse, the E.M.F. millivoltages were again measured and recorded.

Fluoride treatment. A 2% sodium fluoride solution was applied topically to one-half of the maxillary arch of 63 girls. A 2% sodium chloride solution was applied to the remaining maxillary teeth of the 63 girls and to the entire maxillary arch of 15 "double control" girls. The "ion cushion fluoridator" method was employed. Daily applications were made for a period of one week with the final treatment being made the night before the subject's next appointment.

Post-fluoride determinations. Approximately eight to ten hours after the last fluoride application, each girl was seen again, and the E.M.F. millivoltages were recorded both before and after the sugar rinse. Repeated determinations were made on each girl after intervals of eight hours, three days, one week, two weeks and one month. The number of girls who completed the experiment as double controls was inadequate for statistical analysis. The following is a resume of the number of girls who completed each phase of the experiment:

50 girls completed the pre-fluoride determinations

42 girls completed the first post-fluoride determination (8 hours)

32 girls completed the second post-fluoride determination (3-4 days)

34 girls completed the third post-fluoride determination (1 week)

17 girls completed the fourth post-fluoride determination (2 weeks)

13 girls completed the fifth post-fluoride determination (1 month)

An attempt was made to determine the fluoride concentration of the plaques before and after treatment; however, it was found that sufficient plaque material could not be obtained even in pooled samples.

RESULTS AND DISCUSSION

It was the purpose of this investigation to determine whether the addition of topical fluoride to dental plaques would have any effect upon acidogenesis _in situ_.

The hydrogen ion concentration of the dental plaques of the maxillary posterior teeth of forty-two teenage girls was determined both before and after a sugar rinse. These values were compared with similar values obtained at intervals of eight hours, three-to-four days and one week after a 2% topical sodium fluoride treatment on one-half of the maxillary arch. The other half of the arch served as an internal control with 2% sodium chloride rather than sodium fluoride.

The findings of the initial examination of each subject's mouth are summarized in Table 1. In this as in other appropriate tables the test subjects are listed by identification number. The table shows the number of carious tooth surfaces present in each girl's mouth and the total number of tooth surfaces present, whether the surfaces are carious, filled or intact. There are no significant differences over-all between the two sides of the mouth with respect to the numbers of carious surfaces or to the total number of tooth surfaces. Tables D and E in the appendix give the details of the statistical comparison of the two sides.

The mean resting state and sugar-stimulated hydrogen ion concentrations for the test and control sides of each subject are given in Table 2. This table also shows the "differences" between the resting state and sugar-stimulated means. These "differences" are believed to be related to the ability of the plaques to produce acid under the conditions of this experiment. The statistical analyses which follow, therefore, deal primarily with these "differences" and with the corresponding "differences" after treatments with sodium fluoride or sodium chloride. The test and control sides were compared and found to have no significant differences between them with respect to resting state or sugar-stimulated hydrogen ion concentrations. Figure 1 shows the comparison of the grand means of the resting state and sugar-stimulated pH values on the test and control sides. Details of the analyses are given in Tables F, G and H in the appendix.

Tables 3 through 7 give the mean hydrogen ion concentrations for the eight-hour, three-to-four days, one-week, two-weeks and one-month post-treatment periods. The following statistical discussion demonstrates the apparent marked inhibition of acidogenesis by 2% sodium fluoride eight hours post-treatment, the somewhat lessened effect three-to-four days later, and the return to pre-treatment levels at one-week and subsequent intervals.

Figures 2 through 7 are histograms showing the distributions of the various hydrogen ion concentrations given in Tables 2 and 3. It can be seen from these figures that the distributions are markedly skewed. Inasmuch as it is difficult to analyze directly the data taken from populations with skewed distributions, it was important to transform the mean hydrogen ion concentrations into values possessing a more normal distribution. Most investigators are familiar with the negative logarithms of hydrogen ion concentrations (pH), and since these values had a more normal distribution in this experiment, they were used in most of the computations. It should be noted, however, that when an average of a series of logs is taken directly, some error is introduced into the mean. A more correct method is to average the hydrogen ion concentrations and then take the negative logs of the mean.(22) Whenever possible, therefore, the means were determined from the hydrogen ion concentrations.

Statistical Procedures

The assumption was made that if the fluoride applications had no effect upon the ability of the plaques to produce acid, then the grand mean of the "differences" before treatment with sodium fluoride would equal the grand mean of the "differences" after treatment with sodium fluoride. Stated in another way, the grand mean of the "differences" after treatment with sodium fluoride MINUS the grand mean of the "differences" before treatment with sodium fluoride would equal zero (H_o: $\mu_{\bar{x}}$ after treatment — $\mu_{\bar{x}}$ before treatment = 0). The following analyses were performed to test this hypothesis:

1) A test of the difference between the eight-hour post-sodium fluoride treatment mean and the pre-sodium fluoride treatment mean on the test side (H_o: $\mu_{\bar{x}9} - \mu_{\bar{x}3} = 0$).

2) A test of the difference between the eight-hour post-sodium chloride treatment mean and the pre-sodium chloride treatment mean on the control side (H_o: $\mu_{\bar{x}12} - \mu_{\bar{x}6} = 0$).

3) A test of the difference between the three-to-four day post-sodium fluoride treatment mean and the pre-sodium fluoride treatment mean on the test side (H_o: $\mu_{\bar{x}15} - \mu_{\bar{x}3} = 0$).

4) A test of the difference between the three-to-four day post-sodium chloride treatment mean and the pre-sodium chloride treatment mean on the control side (H_0: $\mu_{\bar{x}18} - \mu_{\bar{x}6} = 0$).

5) A test of the difference between the one-week post-sodium fluoride treatment mean and the pre-sodium fluoride treatment mean on the test side (H_0: $\mu_{\bar{x}21} - \mu_{\bar{x}3} = 0$).

6) A test of the difference between the one-week post-sodium chloride treatment mean and the pre-sodium chloride treatment mean on the control side (H_0: $\mu_{\bar{x}24} - \mu_{\bar{x}6} = 0$).

Table 8 gives the results of the analyses, and Tables I through N in the appendix show the details of the computations.

The results are consistent with the stated hypotheses for all control side tests and for the one-week post-treatment analyses on the test side. However, significant differences exist between the pre-treatment means and the post-treatment means for the eight-hour and three-to-four day periods on the test sides.

It was of interest to consider the effects of two covariables upon the ability of the plaques to produce acid. These variables were the number of carious surfaces present in each subject's mouth and the total number of surfaces present, whether carious, filled, or intact. Multiple correlation and regression studies were therefore performed as follows:

1. A multiple regression analysis on the test side with the following variables:

   1.1 Dependent variable

      1.1.1 Increased hydrogen ion concentrations in response to a sugar rinse on the test side eight hours after treatment with sodium fluoride (identification symbol X_9).

1.2 Independent variables

1.2.1 Total number of carious surfaces present in the entire mouth (symbol X_1).

1.2.2 Total number of tooth surfaces present in the entire mouth, whether carious, filled or intact. (symbol X_2).

1.2.3 Increased hydrogen ion concentration in response to a sugar rinse on the test side before treatment with sodium fluoride (symbol X_3).

2. A path coefficient analysis on the test side with the following variables:

2.1 Dependent variable

2.1.1 Increased hydrogen ion concentration in response to a sugar rinse on the test side before treatment with sodium fluroide (symbol X_3).

2.2 Independent variable

2.2.1 Same as 1.2.1 (symbol X_1).

2.2.2 Same as 1.2.2 (symbol X_2).

3. A multiple regression analysis on the control side with the following variables:

3.1 Dependent variable

3.1.1 Increased hydrogen ion concentration in response to a sugar rinse on the control side eight hours after treatment with sodium chloride (symbol X_5).

3.2 Independent variables

3.2.1 The same as 1.2.1 (symbol X_1).

3.2.2 The same as 1.2.2 (symbol X_2).

3.2.3 Increased hydrogen ion concentration in response to a sugar rinse on the control side before treatment with sodium chloride (symbol X_4).

4. A path coefficient analysis on the control side with the following variables:

4.1 Dependent variables

4.1.1 Increased hydrogen ion concentration in response to a sugar rinse on the control side before treatment with sodium chloride (symbol X_4).

4.2 Independent variables

4.2.1 The same as 1.2.1 (symbol X_1).

4.2.2 The same as 1.2.2 (symbol X_2).

The coefficients of determination and F-test values of these studies are given in Table 9 for purposes of comparison. The details of the analyses are given in the appendix in Table 0.

The coefficients of determination on the control side ($R^2_{4.12}$, before treatment with sodium chloride and $R^2_{5.125}$, after treatment with sodium chloride) are similar, and both are significant. This is to say that there is a significant correlation between the dependent variable (increased hydrogen ion concentration after a sugar rinse) and the independent variables (number of carious surfaces and total number of tooth surfaces considered together).

The coefficients of determination on the test side ($R^2_{3.12}$, before treatment with sodium fluoride and $R^2_{6.123}$, after treatment with sodium fluoride) are different. The coefficient of determination before treatment with sodium fluoride is significant, whereas the coefficient of determination after treatment with sodium fluoride is not significant. Thus, a significant correlation existed between the dependent and independent variables before fluoride application, but it no longer existed after the application. This suggests an inhibitory influence on the sugar-stimulated increase in hydrogen ion concentration by the sodium fluoride, but not by the sodium chloride.

Comments

It is well established that when sodium fluoride is added to the community water supply in recommended amounts, a reduction in the incidence of caries results. Davies (23) pointed out that this reduction "... has been demonstrated throughout the world; in different ethnic groups; in different countries; in people with high and low standards of nutrition, and in people with high and low intakes of refined carbohydrate."

There are two theories dealing with the action of fluoride ions in the prevention of tooth decay. The first theory states that the fluoride ion, whether administered during tooth formation or by topical application after eruption, combines with the tooth enamel, rendering it less soluble in acid solutions. The second theory states that the fluoride affects the acid-producing organisms in such a way that acid production is inhibited. Both of these theories may, of course, be operative. If the acid inhibition theory is operative to an appreciable degree, then it seems reasonable to predict that:

1) Persons who live in areas of low water fluoride concentration while their teeth form and erupt, and who then move into areas of high fluoride concentration will experience a reduction in caries incidence.

2) Persons who move from areas of high water fluoride concentration into areas of low concentration will lose some of the caries inhibitory effects.

3) The dental plaques of those persons living in areas of high water fluoride concentration will contain more fluoride than the plaques of individuals residing in areas of low water fluoride concentration.

4) The fluoride in dental plaques is present in a form which is capable of inhibiting acidogenesis.

5) Less acid is produced in the plaques of persons after topical application of sodium fluoride than before such application.

6) Less acid is produced in the plaques of persons residing in areas of high water fluoride concentration than in those living in areas of low water fluoride concentration.

The validity of five of the above six predictions has been documented in recent literature, including this report.

1) The studies of Hill and Blayney (24, 25) show that some anti-caries activity was present in persons whose teeth had formed and erupted prior to any exposure to fluoride in the water supply, but who had received such exposure after tooth eruption.

Klein (26) reported on some Japanese children who were relocated during World War II. Some were sent to an area of high water fluoride concentration and some to an area of low water fluoride concentration. Those residing in the area of high fluoride concentration had a significantly lower caries incidence than those living in the area of low concentration.

2) Russell (16) studied the effects of removal of fluoride from the water supply as well as the removal of individuals from areas of high

water fluoride concentration. He stated, "This inhibitory effect tends to persist so long as fluoride exposure is continued, but tends slowly to be lost after fluoride exposure is discontinued; hence periodic or continuous renewal of the fluoride content of tooth enamel is required for maintenance of the maximum caries-inhibitory effect." It is possible that this could also be true with respect to the fluoride content of the plaques.

3) Dawes, Jenkins, Hardwick and Leach (13) found a statistically significant difference between the fluoride content of plaques (47 ppm) in the mouths of 11-year-old children residing in an area of high fluoridation as opposed to the plaques (26 ppm) of children living in an area of low fluoridation.

4) Jenkins (27) demonstrated that minimal amounts of soluble fluoride was extracted from in vitro plaques when they were washed with equal volumes of saliva at pH 8.5. When the pH was lowered to 5.0, almost complete extraction occurred. It would seem, therefore, that the fluoride probably was available for inhibition of acidogenesis.

5) The present study is consistent with the acid-inhibition hypothesis since it demonstrates such inhibition for periods of up to one week. The eight-hour effect is strongly significant with a high degree of confidence ($\mu_{\bar{x}9} - \mu_{\bar{x}3} = 0.85$; $p= <0.001$). The three-to-four day post-treatment effect is still strongly significant even though it has decreased ($\mu_{\bar{x}15} - \mu_{\bar{x}3} = 0.25$; $p= <0.005$). After one week post-treatment, the effect is no longer demonstrable by a test of the difference of the means. However, because of the increased variance after the one-week period, it is possible that the reduction might extend beyond one week in some of the subjects. It should also be

pointed out that only the outer surface of the plaque was tested with respect to acidogenesis. Inasmuch as the outer surface probably loses its fluoride much more rapidly, it is possible that the fluoride effect lasted for longer periods in the deeper layers of the plaque.

It is not known how much or in what form the topically applied sodium fluoride was eventually incorporated into the plaque. An attempt was made to determine the fluoride concentrations in pooled plaque material before and after treatments, but, unfortunately, sufficient plaque was not available for the analyses. Jenkins (28) pointed out that with the high concentrations of fluoride used in topical applications, calcium fluoride forms on the enamel surface. He believes that calcium fluoride gradually dissolves from the tooth surface to become incorporated into the plaque in a bound form. He concluded that with topical applications, reduction in enamel solubility as well as anti-enzyme effects in the plaque may occur.

6) Although the sixth prediction, "Less acid is produced in the plaques of persons residing in areas of high water fluoride concentration than in those living in areas of low water fluoride concentration," has not been well documented, the assumption that fluoride does exert an inhibitory effect on acidogenesis within the plaque seems justified.

SUMMARY

It was the purpose of this investigation to determine whether the addition of 2% topical sodium fluoride to dental plaques would have any effect upon acid production *in situ*.

The maxillary arches of forty-two teenage girls were divided into test and control sides so that each girl would serve as her own control. The mean hydrogen ion concentrations of the dental plaques of the maxillary posterior teeth were determined both before and after a sugar rinse by the use of an antimony calomel electrode system attached to a Corning pH meter. The test and control sides were found to be statistically similar with respect to the number of carious tooth surfaces present, the total number of tooth surfaces present, the mean hydrogen ion concentration before a sugar rinse, and the mean hydrogen ion concentration after a sugar rinse.

The "differences" between the pre-sugar and post-sugar hydrogen ion concentrations were determined. These "differences" are believed to be related to the ability of the dental plaques to produce acid in response to a sugar rinse; and for this reason, the "differences" constitute the data evaluated in the statistical procedures.

A 2% solution of sodium fluoride was applied to the teeth of the test side, and, at the same time, a 2% solution of sodium chloride was applied to the teeth on the control side. At intervals of eight hours,

three-to-four days, one week, two weeks and one month after the sodium fluoride or sodium chloride treatment, the pre-sugar and post-sugar hydrogen ion concentrations were again determined. The post-treatment "differences" (sugar-stimulated hydrogen ion concentrations minus resting state hydrogen ion concentrations) were statistically compared with the comparable pre-treatment "differences".

Fewer free hydrogen ions were produced by the plaques in response to a sugar rinse on the test side eight hours after treatment with sodium fluoride than were produced by the same plaques before sodium fluoride treatment, or by the contralateral sodium chloride treated plaques, (statistically significant $p < 0.001$). The three-to-four day post sodium fluoride "differences" were also significantly decreased but at a lower level of confidence ($p < 0.005$). The one-week "differences" were not significantly changed from the pre-sodium fluoride " "differences," and the control side was left unaffected by the sodium chloride applications.

Multiple regression analyses were also performed to determine what effects the presence of caries and the total number of tooth surfaces present would have on the outcome of the experiment. A significant correlation existed between hydrogen ion production as estimated by the "differences" between pre-and post-sugar rinse hydrogen ion concentrations and the combined effect of the two independent variables (carious surfaces and total number of surfaces) before the application of sodium fluoride or sodium chloride. After the sodium fluoride or sodium chloride treatment the correlation became insignificant on the test side but remained significant on the control side. This finding suggests the inhibition of acid production on the test side since the number of carious surfaces and the total number of tooth surfaces were not altered by the test procedures.

It was concluded that the topical application of 2% sodium fluoride to the dental plaques _in situ_ resulted in the decreased production of free hydrogen ions for periods of up to one week. A reduction for longer periods of time could not be demonstrated under the conditions of this experiment; however, the possibility of its occurrence has been suggested in the "Discussion".

TABLE 1 : COMPARISON OF CARIOUS SURFACES AND TOTAL SURFACES, CARIOUS OR OTHERWISE, ON TEST AND CONTROL SIDES

Ident. number	Carious Surfaces: Test Side Y_1	Carious Surfaces: Control Side Y_2	Carious Surfaces: Total Y_3	Total Surfaces: Test Side Z_1	Total Surfaces: Control Side Z_2	Total Surfaces: Total Z_3
1	4	1	5	64	59	123
4	0	0	0	64	64	128
5	10	2	12	64	64	128
6	1	8	9	50	59	109
7	0	0	0	64	64	128
8	6	9	15	64	64	128
9	5	10	15	64	59	123
10	9	7	16	60	64	124
11	1	0	1	64	64	128
12	0	2	2	59	54	113
13	6	7	13	59	59	118
14	2	7	9	54	59	113
15	0	2	2	59	64	123
16	9	17	26	64	64	128
17	9	2	11	64	59	123
18	5	0	5	64	64	128
20	4	7	11	59	59	118
21	8	4	12	59	59	118
22	0	0	0	64	64	128
24	10	20	30	54	59	113
25	16	11	27	64	59	123
26	2	1	3	64	64	128
28	0	0	0	49	49	98
30	0	0	0	64	64	128
31	10	14	24	59	59	118
32	0	1	1	64	64	128
33	1	0	1	64	59	123
34	17	20	37	64	64	128

TABLE 1: COMPARISON OF CARIOUS SURFACES AND TOTAL SURFACES, CARIOUS OR OTHERWISE, ON TEST AND CONTROL SIDES (Continued)

Ident. number	Carious Surfaces Test Side Y_1	Carious Surfaces Control Side Y_2	Carious Surfaces Total Y_3	Total Surfaces Test Side Z_1	Total Surfaces Control Side Z_2	Total Surfaces Total Z_3
35	3	2	5	64	64	128
36	4	1	5	64	64	128
37	8	7	15	64	64	128
38	5	5	10	54	54	108
40	4	7	11	59	64	123
42	4	2	6	64	64	128
43	12	10	22	54	49	103
45	3	4	7	64	64	128
46	0	0	0	64	64	128
47	21	20	41	59	64	123
48	6	7	13	54	49	103
49	1	0	1	64	64	128
50	2	1	3	64	59	123
51	6	11	17	64	64	128
Totals	214	229	443	2565	2558	5123
Means	5.09	5.45	10.55	61.07	60.90	121.98

There is no significant difference between test and control sides at the 90% level of significance.

There is no significant difference between test and control sides at the 90% level of significance.

TABLE 2 : COMPARISON OF MEAN HYDROGEN ION CONCENTRATIONS OF TEST AND CONTROL PLAQUES IN SITU before and after a sugar rinse and before topical application of sodium fluoride or sodium chloride

Ident.	Test Side $[H^+] \times 10^{-7}$			Control Side $[H^+] \times 10^{-7}$		
number	Resting state X_1	Sugar stimulated X_2	Difference X_3	Resting state X_4	Sugar stimulated X_5	Difference X_6
1	1.027	2.339	1.312	1.492	5.324	3.832
4	1.461	43.238	41.777	1.280	32.241	30.961
5	1.173	27.486	26.313	4.218	9.776	5.558
6	1.205	7.540	6.335	1.126	8.909	7.783
7	1.064	18.844	17.780	1.473	27.256	25.783
8	.631	22.689	22.058	.876	34.716	33.840
9	5.116	31.356	26.240	4.522	25.214	20.692
10	2.910	14.323	11.413	3.819	15.847	12.028
11	.686	6.066	5.380	.561	12.654	12.093
12	1.892	9.032	7.140	2.156	6.653	4.497
13	1.999	13.067	11.068	1.493	9.085	7.592
14	.906	20.170	19.264	.639	37.170	36.531
15	29.633	66.577	36.944	19.370	51.023	31.653
16	2.140	14.620	12.480	2.922	15.061	12.139
17	.700	28.815	28.115	.486	13.945	13.459
18	4.140	13.364	9.224	4.710	14.803	10.093
20	.653	12.719	12.066	.871	20.225	19.354
21	1.448	7.830	6.382	1.458	11.932	10.474
22	3.263	37.477	34.214	2.266	32.255	29.989
24	5.564	43.466	37.902	3.910	42.913	39.003
25	1.766	57.966	56.200	2.119	75.477	73.358
26	3.339	46.466	43.127	3.118	20.424	17.306
28	1.571	7.930	6.359	1.236	7.874	6.638
30	1.005	19.122	18.117	1.505	22.088	20.583
31	3.127	74.400	71.273	2.388	99.611	97.223
32	10.456	25.355	14.899	6.461	21.939	15.478
33	1.088	8.158	7.070	1.435	5.846	4.411

TABLE 2 : COMPARISON OF MEAN HYDROGEN ION CONCENTRATIONS OF TEST AND CONTROL PLAQUES IN SITU before and after a sugar rinse and before topical application of sodium fluoride or sodium chloride

Ident. number	Test Side $[H^+] \times 10^{-7}$ Resting state X_1	Sugar stimulated X_2	Difference X_3	Control Side $[H^+] \times 10^{-7}$ Resting state X_4	Sugar stimulated X_5	Difference X_6
34	1.716	32.623	30.907	1.375	50.856	49.481
35	1.018	14.883	13.865	.425	28.325	27.900
36	2.711	12.453	9.742	3.211	9.203	5.992
37	2.507	25.244	22.737	2.979	27.305	24.326
38	1.972	23.807	21.835	1.440	22.773	21.333
40	.995	19.580	18.585	.522	14.246	13.724
42	2.213	37.712	35.499	1.764	45.255	43.491
43	4.073	20.595	16.522	3.883	77.514	73.631
45	.881	54.722	53.841	1.282	48.858	47.576
46	1.050	20.869	19.819	3.206	11.354	8.148
47	1.684	49.244	47.560	2.160	76.577	74.417
48	2.436	48.088	45.652	1.677	59.055	57.378
49	1.875	7.821	5.946	1.027	8.705	7.678
50	1.216	29.907	28.691	1.361	25.303	23.942
51	2.264	32.033	29.769	2.858	41.289	38.431
Totals	118.574	1109.996	991.422	107.080	1226.879	1119.799
Means	2.823	26.428	23.605	2.550	29.212	26.662

There is no significant difference between $\bar{X}_1$ and $\bar{X}_4$ at the 90% level of significance.
There is no significant difference between $\bar{X}_2$ and $\bar{X}_5$ at the 90% level of significance.
There is a significant difference between $\bar{X}_3$ and $\bar{X}_6$ at the 90% level of significance but not at the 95% level.

TABLE 3 : COMPARISON OF MEAN HYDROGEN ION CONCENTRATIONS OF TEST AND CONTROL PLAQUES IN SITU before and after a sugar rinse and eight hours after topical application of sodium fluoride or sodium chloride

Ident. number	Test Side $[H^+] \times 10^{-7}$ Resting state X_7	Sugar stimulated X_8	Difference X_9	Control Side $[H^+] \times 10^{-7}$ Resting state X_{10}	Sugar stimulated X_{11}	Difference X_{12}
1	1.047	1.320	.273	1.273	10.340	9.067
4	.778	5.180	4.402	.661	73.633	72.972
5	1.767	2.090	.323	4.567	22.900	18.333
6	.887	4.567	3.680	1.444	5.153	3.709
7	1.716	7.803	6.087	.661	14.106	13.445
8	.518	1.320	.802	1.047	29.600	28.553
9	1.953	4.780	2.827	4.543	20.470	15.927
10	4.623	5.153	.530	2.326	12.433	10.107
11	.518	3.230	2.712	.447	17.233	16.786
12	4.250	6.843	2.593	2.936	7.020	4.048
13	1.480	5.153	3.673	.887	5.683	4.796
14	1.320	2.830	1.510	.661	13.147	12.486
15	21.163	24.597	3.434	4.127	14.803	10.676
16	1.953	8.137	6.184	1.480	11.340	9.860
17	1.208	2.313	1.105	1.207	21.203	19.996
18	13.770	29.600	15.830	16.200	46.733	30.533
20	1.593	13.467	11.874	.631	40.983	40.352
21	2.327	5.707	3.380	1.557	13.553	11.996
22	3.466	14.107	10.641	1.953	10.223	8.280
24	3.467	4.780	1.313	4.383	34.837	30.454
25	1.544	11.340	9.796	.887	50.167	49.280
26	2.857	4.623	1.766	2.857	19.917	17.060
28	1.930	10.510	8.580	4.750	38.566	33.816
30	.702	11.000	10.298	1.320	23.933	22.613
31	1.953	10.233	8.280	.934	18.967	18.033
32	5.707	5.683	-.024	9.450	32.817	23.367
33	.887	2.563	1.676	.661	4.370	3.709

TABLE 3 : COMPARISON OF MEAN HYDROGEN ION CONCENTRATIONS OF TEST AND CONTROL PLAQUES IN SITU before and after a sugar rinse and eight hours after topical application of sodium fluoride or sodium chloride

Ident. number	Test Side $[H^+] \times 10^{-7}$			Control Side $[H^+] \times 10^{-7}$		
	Resting state X_7	Sugar stimulated X_8	Difference X_9	Resting state X_{10}	Sugar stimulated X_{11}	Difference X_{12}
34	1.557	4.217	2.660	2.584	24.500	21.916
35	.934	2.443	1.509	.904	19.663	18.759
36	1.484	3.997	2.513	1.593	16.200	14.607
37	.887	3.840	2.953	1.443	13.770	12.327
38	1.127	3.877	2.750	.921	16.200	15.279
40	.259	1.320	1.061	.192	13.893	13.647
42	2.074	13.770	11.696	1.047	48.700	47.653
43	1.557	3.310	1.753	1.320	5.687	4.367
45	1.652	4.233	2.581	2.203	32.366	30.163
46	2.333	3.860	1.527	1.480	4.360	2.880
47	9.233	14.107	4.874	10.810	96.300	85.490
48	1.283	6.466	5.183	.774	44.766	43.992
49	2.937	3.803	.866	1.953	15.366	13.413
50	1.047	5.937	4.890	1.047	16.537	15.490
51	1.717	5.683	3.966	2.563	25.667	23.104
Totals	115.465	289.792	174.327	104.684	1008.105	903.341
Means	2.75	6.90	4.15	2.49	24.002	21.508

TABLE 4 : COMPARISON OF MEAN HYDROGEN ION CONCENTRATIONS OF TEST AND CONTROL PLAQUES IN SITU before and after a sugar rinse and 3-4 days after topical application of sodium fluoride or sodium chloride

Ident. number	Test Side $[H^+] \times 10^{-7}$			Control Side $[H^+] \times 10^{-7}$		
	Resting state X_{13}	Sugar stimulated X_{14}	Difference X_{15}	Resting state X_{16}	Sugar stimulated X_{17}	Difference X_{18}
1	1.047	.934	-.113	.975	13.200	12.225
4	.934	3.840	2.906	1.047	7.803	6.756
5	1.657	8.910	7.253	1.610	19.470	17.860
6	2.937	5.153	2.216	1.557	10.233	8.676
7	1.320	18.967	17.647	1.444	40.033	38.589
8	.631	10.170	9.539	.589	21.777	21.188
9	4.370	31.867	27.497	3.840	7.250	3.410
10	2.327	18.967	16.640	4.250	21.733	17.483
11	.447	1.717	1.270	.541	11.903	11.362
12	2.090	7.803	5.713	1.953	11.687	9.734
13	1.320	6.467	5.147	1.160	7.803	6.643
14	3.725	6.193	2.468	1.249	21.593	20.344
15	3.513	17.603	14.090	3.513	10.340	6.827
21	.887	13.216	12.329	1.063	15.983	14.920
22	1.544	21.733	20.189	1.793	19.917	18.124
28	2.703	42.500	39.797	4.183	20.733	16.550
30	.862	24.500	23.638	1.397	40.033	38.636
33	.887	13.553	12.666	.934	13.770	12.836
34	1.443	35.800	34.357	1.283	54.070	52.787
35	1.643	8.197	6.554	.398	2.690	2.292
36	1.170	10.170	9.000	2.347	9.450	7.103
37	1.047	24.500	23.453	1.283	22.900	21.617
38	1.047	62.700	61.653	1.372	18.967	17.595
40	.724	3.240	2.516	.975	11.770	10.795
42	.774	14.750	13.976	1.350	31.866	30.516
43	1.047	16.536	15.489	1.047	67.700	66.653
45	1.433	5.587	4.154	2.287	17.803	15.516

TABLE 4: COMPARISON OF MEAN HYDROGEN ION CONCENTRATIONS OF TEST AND CONTROL PLAQUES IN SITU before and after a sugar rinse and 3-4 days after topical application of sodium fluoride or sodium chloride

Ident. number	Test Side $[H^+] \times 10^{-7}$			Control Side $[H^+] \times 10^{-7}$		
	Resting state X_{13}	Sugar stimulated X_{14}	Difference X_{15}	Resting state X_{16}	Sugar stimulated X_{17}	Difference X_{18}
46	4.783	8.713	3.930	5.623	12.120	6.497
48	.887	28.433	27.546	1.047	58.500	57.453
49	1.544	16.703	15.159	1.160	20.470	19.310
50	.774	6.433	5.659	.774	19.303	18.529
51	4.370	21.733	17.363	2.327	35.800	33.473
Totals	55.887	517.588	461.701	56.371	698.670	642.299
Means	1.746	16.175	14.428	1.762	21.833	20.072

TABLE 5 : COMPARISON OF MEAN HYDROGEN ION CONCENTRATIONS OF TEST AND CONTROL PLAQUES IN SITU before and after a sugar rinse and one week after topical application of sodium fluoride or sodium chloride

Ident. number	Test Side $[H^+] \times 10^{-7}$ Resting state X_{19}	Sugar stimulated X_{20}	Difference X_{21}	Control Side $[H^+] \times 10^{-7}$ Resting state X_{22}	Sugar stimulated X_{23}	Difference X_{24}
1	.934	6.060	5.126	1.557	11.770	10.213
4	1.793	13.553	11.760	.774	22.683	21.909
5	1.443	5.313	3.870	1.089	16.397	15.308
6	1.480	11.340	9.860	2.167	13.553	11.386
7	.774	8.357	7.583	.887	13.000	17.113
8	.339	17.233	16.894	.934	3.760	2.826
9	2.703	6.467	3.764	1.680	5.707	4.027
10	2.857	28.433	25.576	3.243	69.400	66.157
11	.518	1.717	1.199	.702	4.250	3.548
12	2.327	5.177	2.850	1.160	4.780	3.620
13	1.953	14.803	12.850	1.480	6.467	4.987
17	.808	11.770	10.962	.522	7.770	7.248
18	5.937	20.000	14.063	10.787	84.367	73.580
20	1.433	29.436	28.003	.976	24.500	23.524
21	1.160	18.967	17.807	1.320	17.233	15.913
22	1.680	63.066	61.386	1.286	29.600	28.314
24	2.326	22.903	20.577	3.230	26.616	23.386
25	.887	38.567	37.680	1.207	37.267	36.060
26	2.427	31.867	29.440	2.326	40.033	37.707
28	.976	7.267	6.291	2.013	10.340	8.327
30	.518	5.103	4.585	1.000	17.400	16.400
31	1.099	31.867	30.768	.702	40.033	39.331
33	.774	10.787	10.013	.702	6.467	5.765
34	3.083	38.567	35.484	1.556	63.067	61.511
35	1.593	28.433	26.840	.814	16.967	16.153
40	.995	4.070	3.075	.707	19.305	18.603
42	.661	42.000	41.339	1.930	25.666	23.736

TABLE 5: COMPARISON OF MEAN HYDROGEN ION CONCENTRATIONS OF TEST AND CONTROL PLAQUES IN SITU before and after a sugar rinse and one week after topical application of sodium fluoride or sodium chloride

Ident. number	Test Side $[H^+] \times 10^{-7}$			Control Side $[H^+] \times 10^{-7}$		
	Resting state X_{19}	Sugar stimulated X_{20}	Difference X_{21}	Resting state X_{22}	Sugar stimulated X_{23}	Difference X_{24}
43	1.047	31.866	30.819	2.802	73.633	70.831
45	1.160	21.593	20.433	3.803	42.500	38.697
46	1.320	14.983	13.663	3.550	21.593	18.043
47	1.930	126.133	124.203	.934	12.216	11.282
48	.661	83.766	83.105	.887	160.333	159.446
49	3.466	28.433	24.967	2.326	21.733	19.407
51	3.840	44.766	40.926	5.500	65.466	59.966
Totals	56.902	874.663	817.761	66.548	1035.872	969.324
Means	1.674	25.725	24.05	1.957	30.467	28.510

TABLE 6 : COMPARISON OF MEAN HYDROGEN ION CONCENTRATIONS OF TEST AND CONTROL PLAQUES IN SITU before and after a sugar rinse and two weeks after topical application of sodium fluoride or sodium chloride

Ident. number	Test Side $[H^+] \times 10^{-7}$ Resting state X_{25}	Test Side Sugar stimulated X_{26}	Test Side Difference X_{27}	Control Side $[H^+] \times 10^{-7}$ Resting state X_{28}	Control Side Sugar stimulated X_{29}	Control Side Difference X_{30}
1	1.320	3.260	1.940	1.320	2.873	1.553
5	1.817	13.493	11.676	2.837	8.697	5.860
11	.518	2.327	1.809	.399	2.327	1.928
14	.331	17.660	17.329	1.009	15.536	14.527
15	17.967	69.400	51.433	12.770	34.633	21.863
17	.737	19.303	18.566	.541	31.867	31.326
18	4.947	13.000	8.053	5.707	53.517	47.810
25	1.657	56.500	54.843	1.207	59.267	58.060
26	4.406	32.367	27.961	4.567	28.433	23.866
28	1.706	5.473	3.767	2.327	12.463	10.136
30	1.160	46.735	45.575	1.207	29.100	27.893
31	2.700	113.600	110.900	1.207	111.767	110.560
36	2.563	12.733	10.170	2.700	7.020	4.320
37	1.000	21.167	20.167	1.170	25.667	24.497
38	.934	21.733	20.799	1.557	16.537	14.980
47	1.000	25.666	24.666	1.283	16.536	15.253
51	2.326	36.300	33.974	2.937	23.933	20.996
Totals	47.089	510.717	463.628	44.745	480.173	435.428
Means	2.77	30.04	27.27	2.63	28.25	25.61

TABLE 7 : COMPARISON OF MEAN HYDROGEN ION CONCENTRATIONS OF TEST AND CONTROL PLAQUES IN SITU before and after a sugar rinse and one month after topical application of sodium fluoride or sodium chloride

Ident. number	Test Side $[H^+] \times 10^{-7}$			Control Side $[H^+] \times 10^{-7}$		
	Resting state X_{31}	Sugar stimulated X_{32}	Difference X_{33}	Resting state X_{34}	Sugar stimulated X_{35}	Difference X_{36}
7	1.160	29.100	27.940	1.160	32.367	31.207
16	.589	5.333	4.744	.887	7.763	6.876
18	1.953	5.153	3.200	.934	7.020	6.086
20	.774	13.770	12.996	.518	16.537	16.019
25	1.443	32.366	30.923	1.320	26.133	24.813
34	1.135	18.750	17.615	1.207	19.303	18.096
35	.774	8.910	8.136	.518	18.967	18.449
36	2.327	9.473	7.146	2.957	7.503	4.546
37	1.556	25.667	24.111	1.953	13.770	11.817
38	1.930	18.967	17.037	1.793	15.983	14.190
40	.370	7.020	6.650	.975	20.733	19.758
46	2.203	19.917	17.714	3.466	22.903	19.437
47	2.856	29.600	26.744	5.153	21.733	16.580
Totals	19.070	224.026	204.956	22.841	230.715	207.874
Means	1.47	17.23	15.76	1.76	17.75	15.99

Figure 1: THE GRAND MEANS OF THE RESTING STATE AND SUGAR-STIMULATED pH VALUES ON TEST AND CONTROL SIDES.

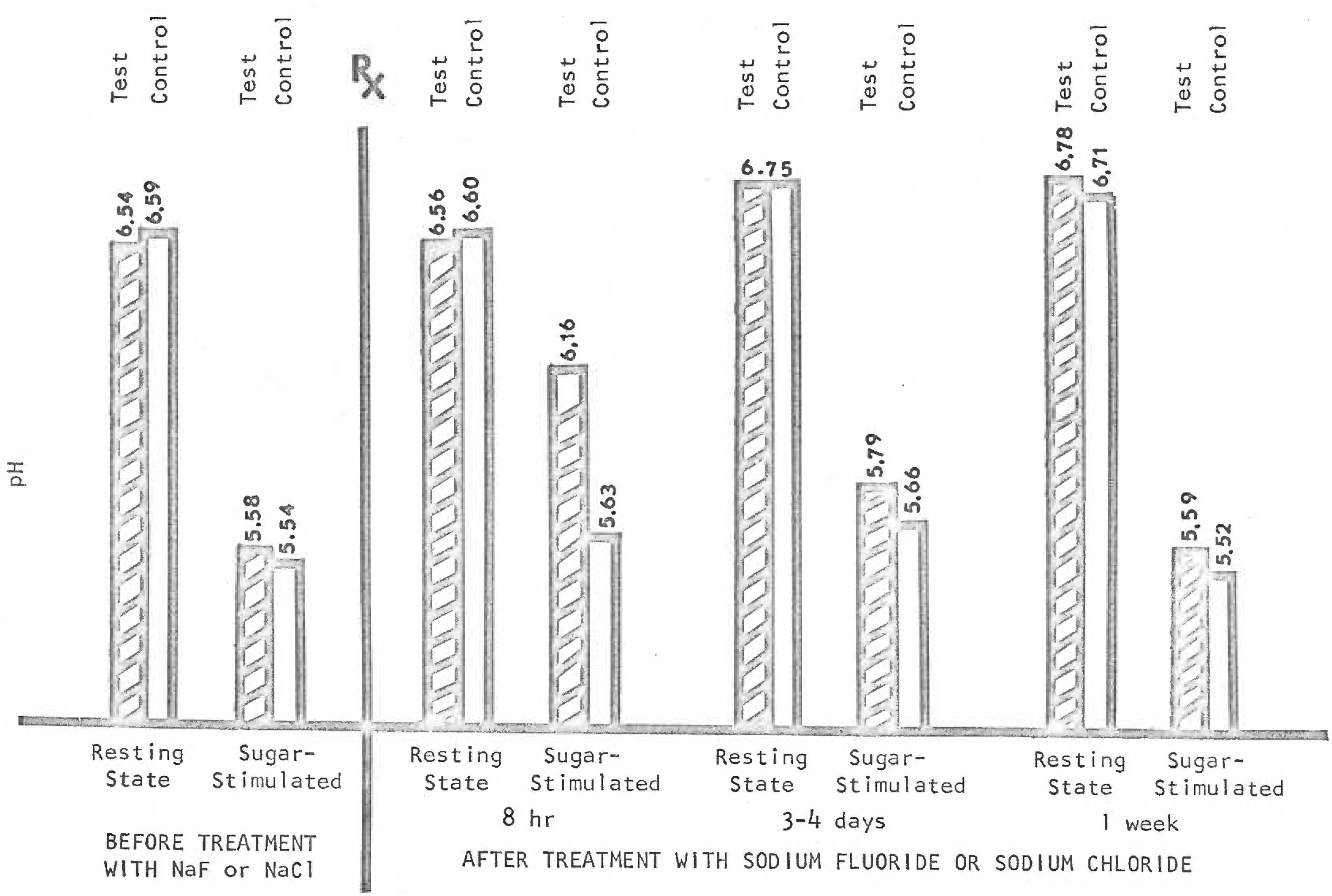


Figure 2. DISTRIBUTION OF MEAN HYDROGEN ION CONCENTRATIONS OF DENTAL PLAQUES ON INDIVIDUAL TEST AND CONTROL SIDES IN SITU before topical application of sodium fluoride or sodium chloride and before sugar stimulation.

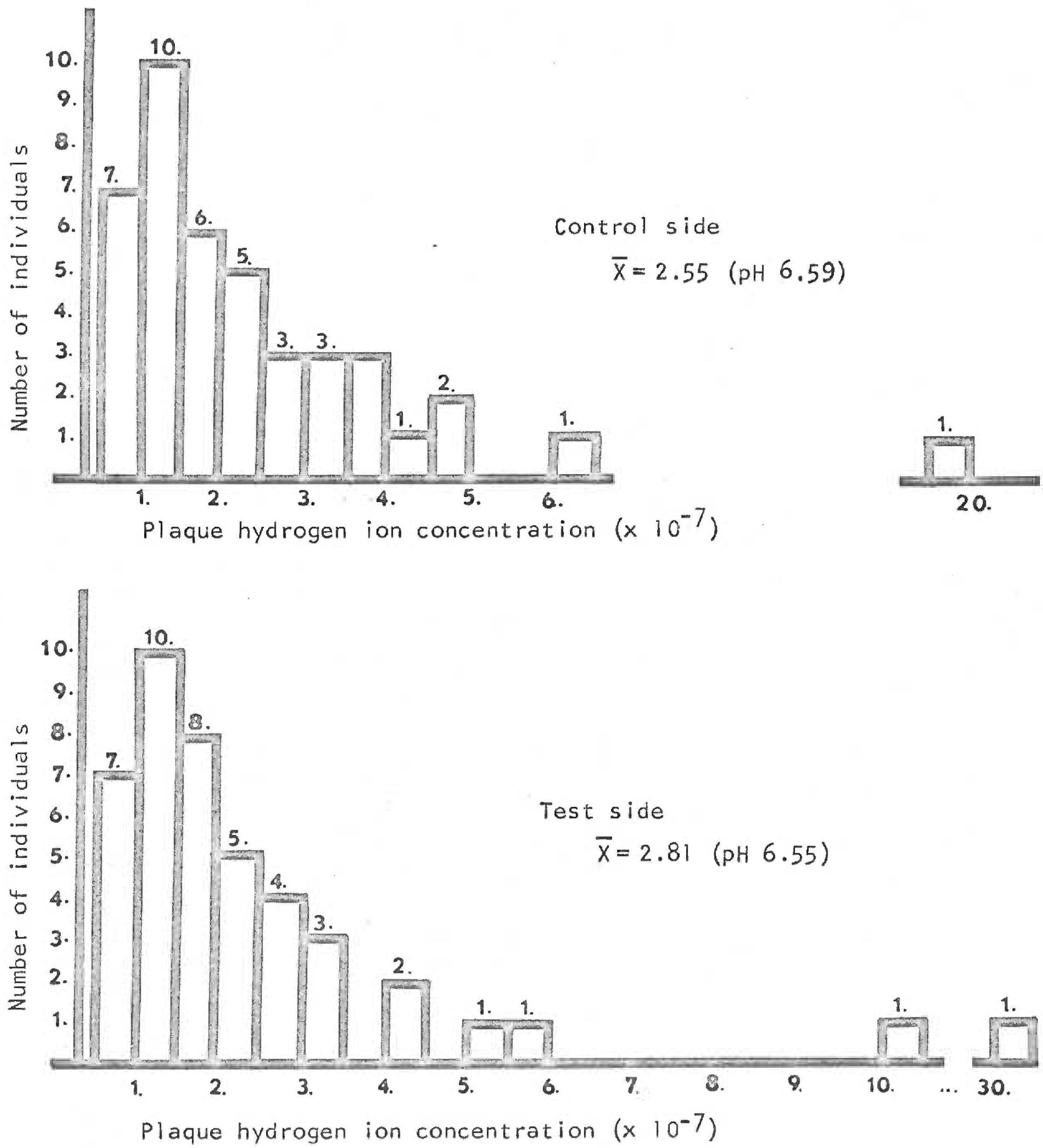
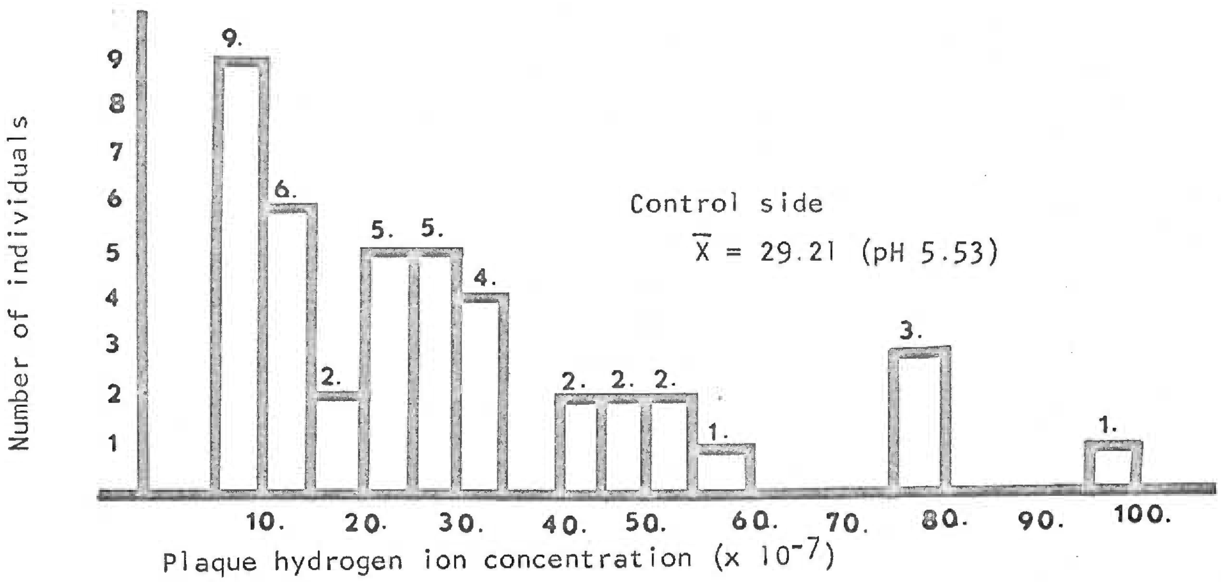


Figure 3. DISTRIBUTION OF MEAN HYDROGEN ION CONCENTRATIONS OF DENTAL PLAQUES ON INDIVIDUAL TEST AND CONTROL SIDES IN SITU before topical application of sodium fluoride or sodium chloride and after sugar stimulation.



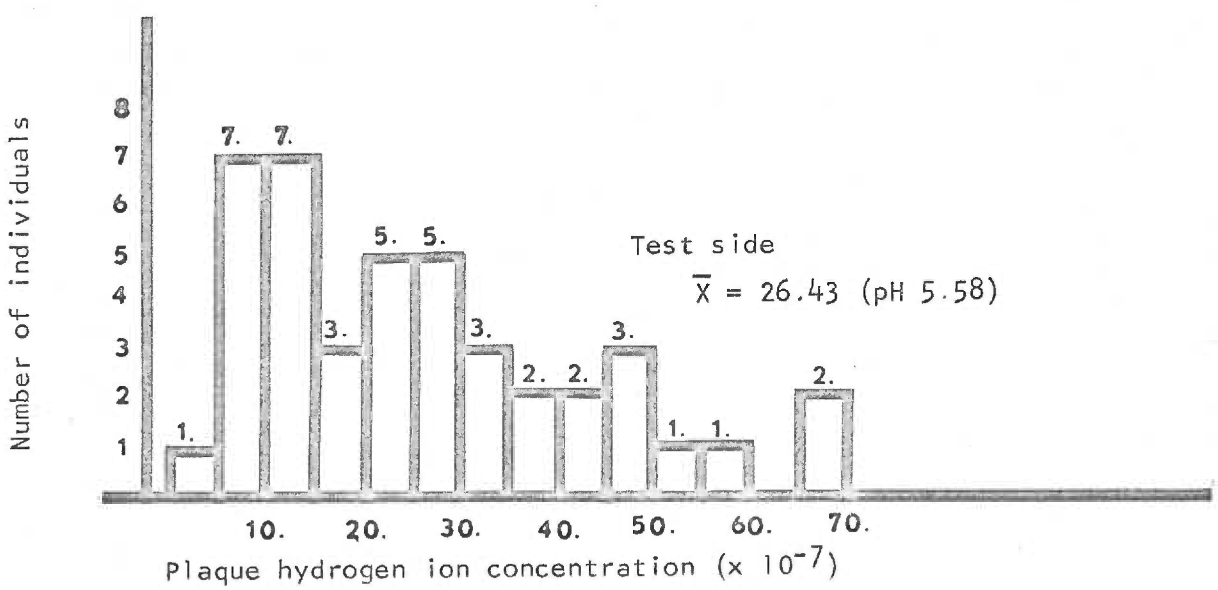


Figure 4. DISTRIBUTION OF THE DIFFERENCES BETWEEN THE MEANS OF THE RESTING STATE AND SUGAR-STIMULATED HYDROGEN ION CONCENTRATIONS ON THE TEST AND CONTROL SIDES before topical application of Sodium Fluoride and Sodium Chloride.

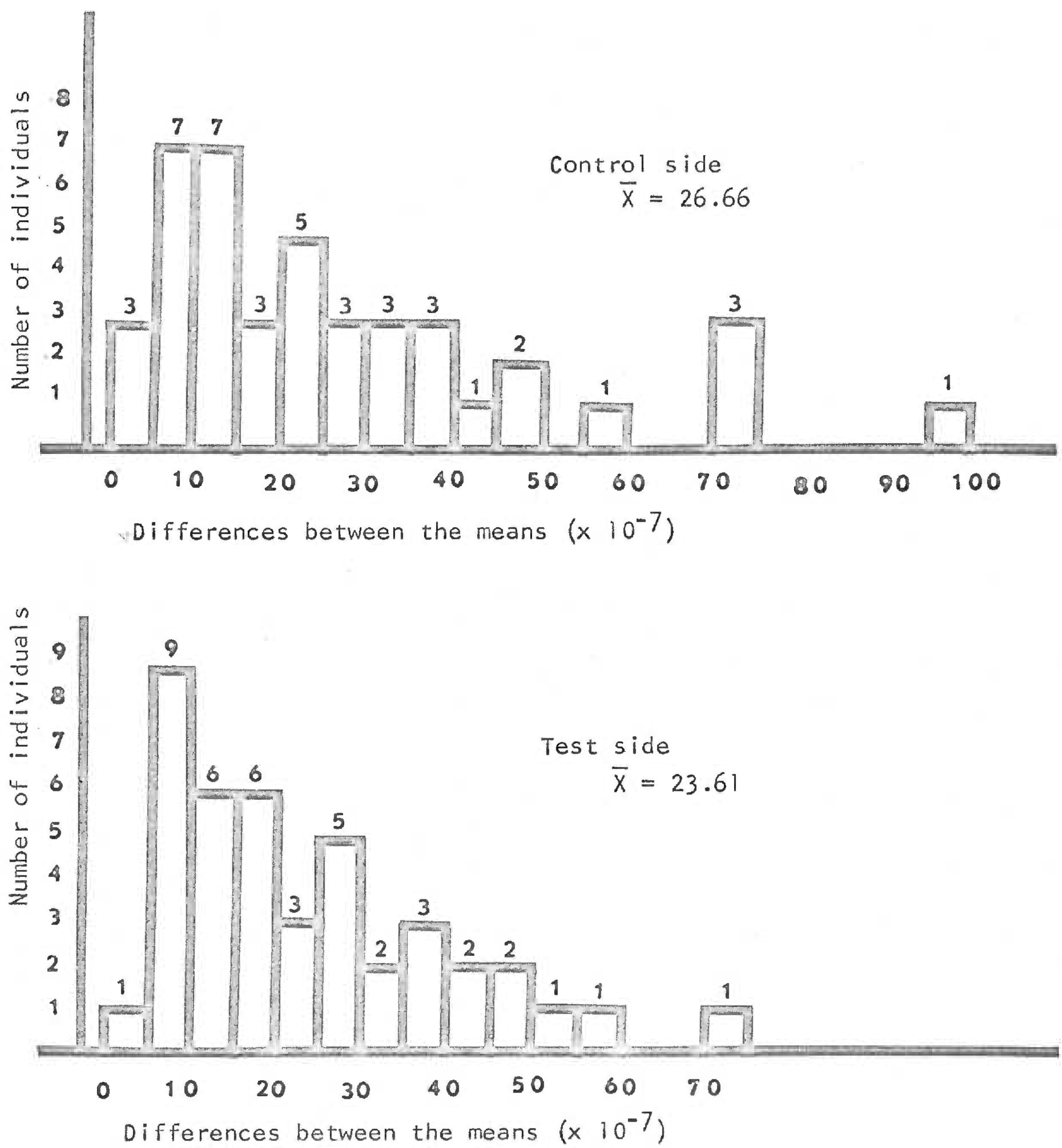


Figure 5. DISTRIBUTION OF MEAN HYDROGEN ION CONCENTRATIONS OF DENTAL PLAQUES ON INDIVIDUAL TEST AND CONTROL SIDES <u>IN SITU</u> eight hours after topical application of sodium fluoride or sodium chloride and before sugar stimulation.

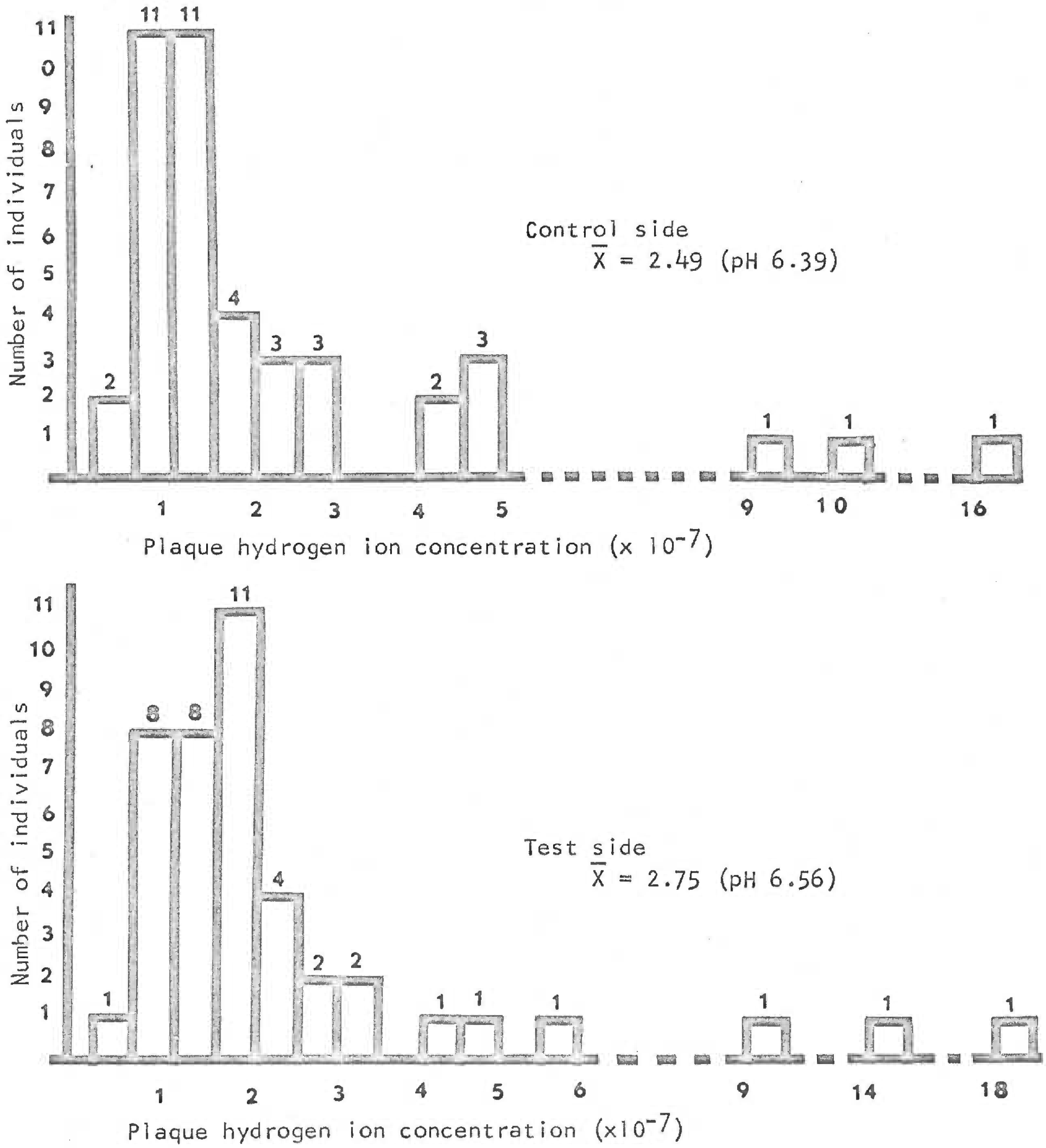


Figure 6. DISTRIBUTION OF MEAN HYDROGEN ION CONCENTRATIONS OF DENTAL PLAQUES ON INDIVIDUAL TEST AND CONTROL SIDES IN SITU eight hours after topical application of sodium fluoride or sodium chloride and after sugar stimulation.

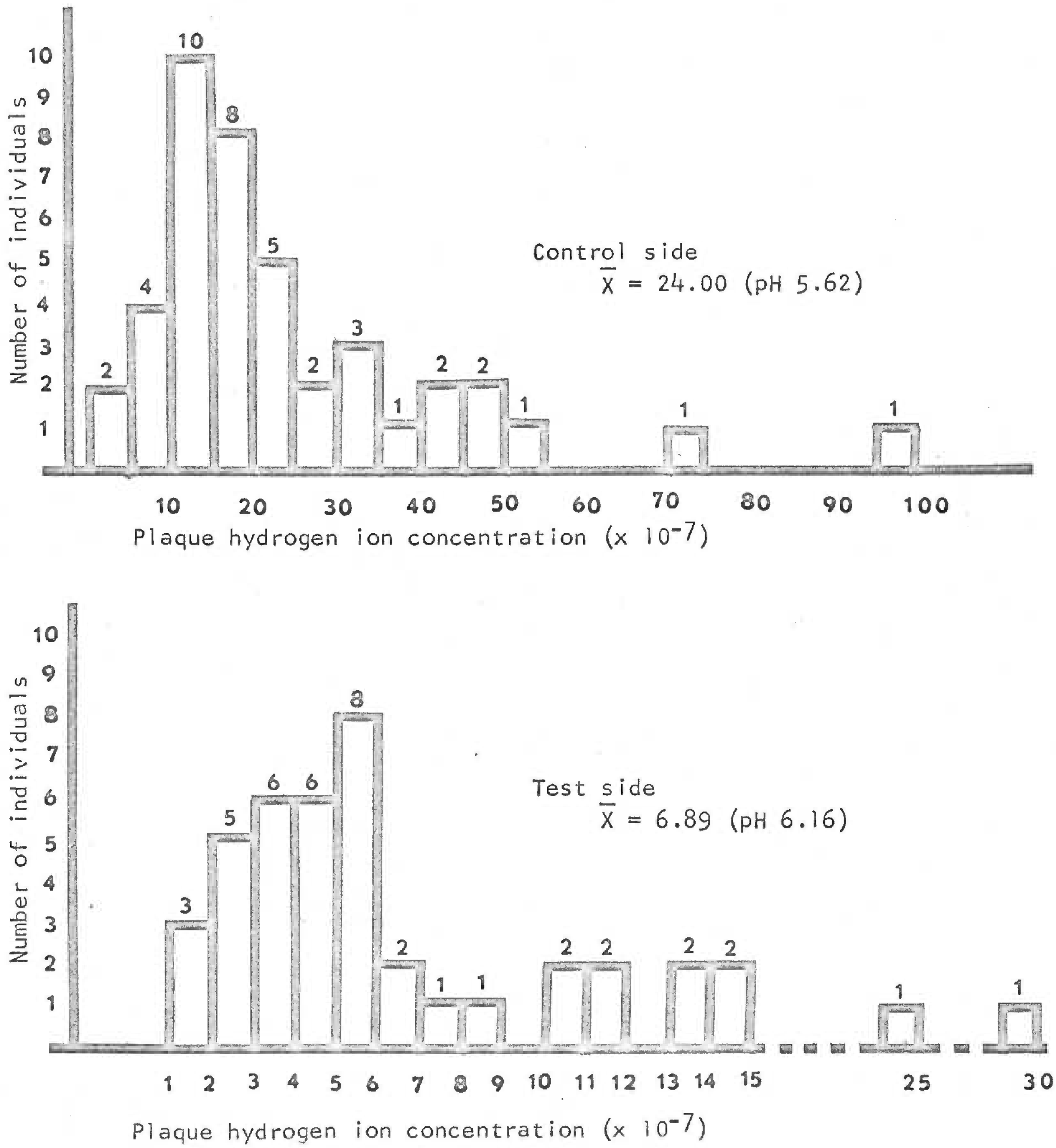
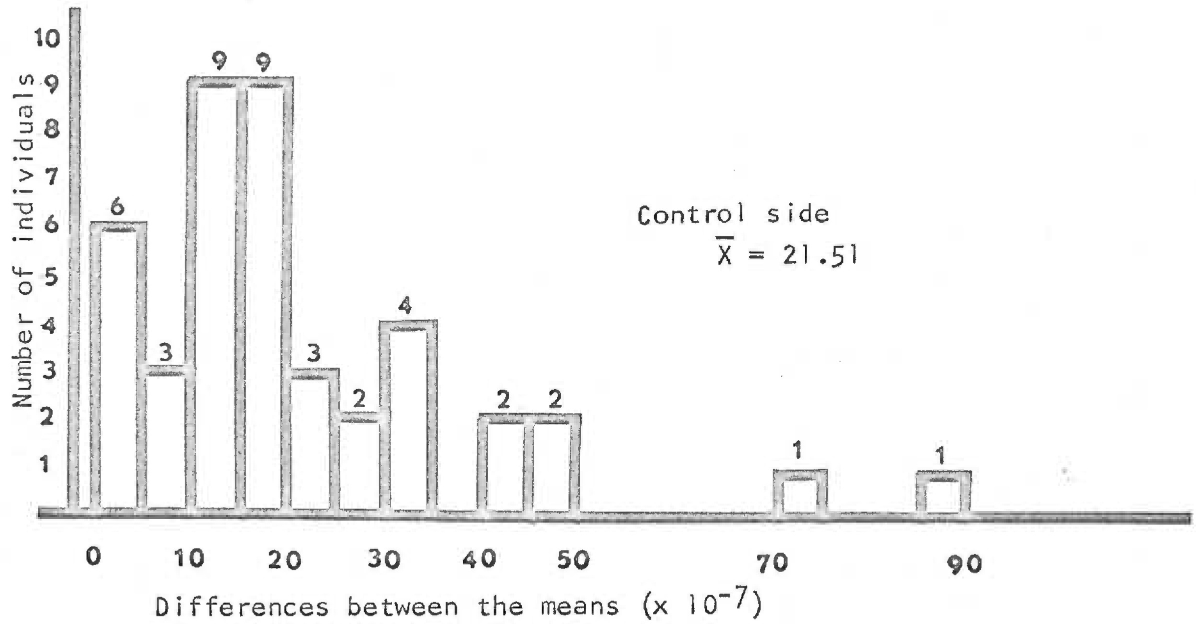


Figure 7. DISTRIBUTION OF THE DIFFERENCES BETWEEN THE MEANS OF THE RESTING STATE AND SUGAR-STIMULATED HYDROGEN ION CONCENTRATIONS ON THE TEST AND CONTROL SIDES eight hours after topical application of sodium fluoride and sodium chloride.



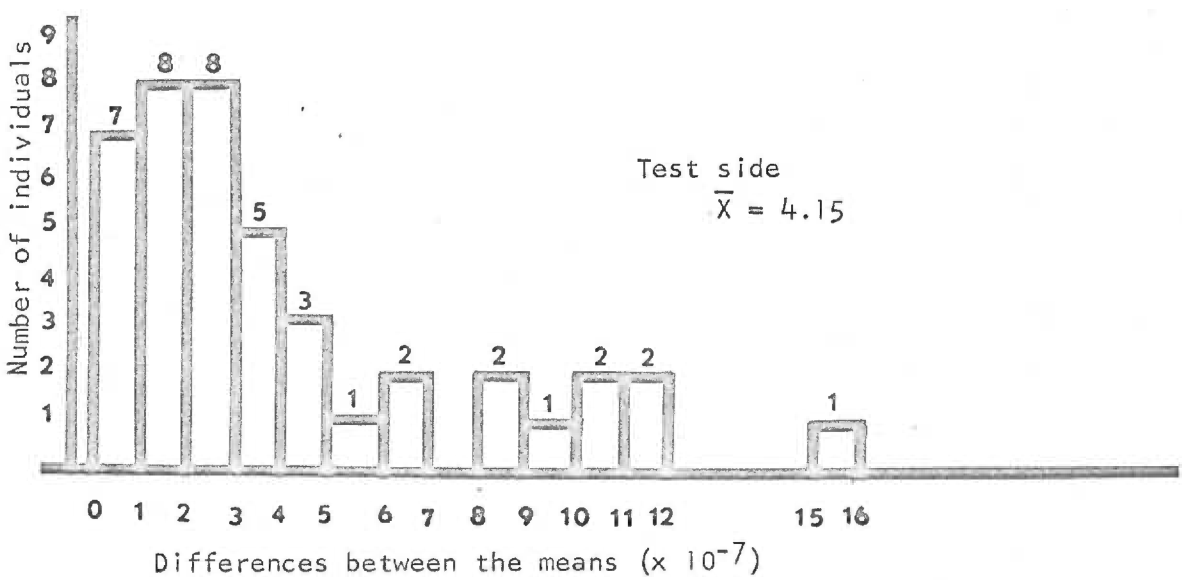


TABLE 8 : RESULTS OF t-TESTS: DIFFERENCES OF THE BEFORE TREATMENT AND AFTER TREATMENT MEANS ON THE TEST AND CONTROL SIDES

Test Side	Control Side
8 hours after treatment	
$H_o: \mu_{\bar{X}_9} - \mu_{\bar{X}_3} = 0$	$H_o: \mu_{\bar{X}_{12}} - \mu_{\bar{X}_6} = 0$
$-\log \bar{X}_9 = 6.59$ $-\log \bar{X}_3 = 5.74$	$-\log \bar{X}_{12} = 5.81$ $-\log \bar{X}_6 = 5.72$
$S_9 = .5224$ $S_3 = .3535$	$S_{12} = .3507$ $S_6 = .3735$
$(-\log \bar{X}_9) - (-\log \bar{X}_3) = 0.85$	$(-\log \bar{X}_{12}) - (-\log \bar{X}_6) = -0.08$
$t_{.99} = \pm 0.286$ d.f. = 41	$t_{.80} = \pm 0.102$ d.f. = 41
∴ reject H_o	∴ accept H_o
3-4 days after treatment	
$H_o: \mu_{\bar{X}_{15}} - \mu_{\bar{X}_3} = 0$	$H_o: \mu_{\bar{X}_{18}} - \mu_{\bar{X}_6} = 0$
$-\log \bar{X}_{15} = 6.05$ $-\log \bar{X}_3 = 5.80$	$-\log \bar{X}_{18} = 5.81$ $-\log \bar{X}_6 = 5.77$
$S_{15} = .5343$ $S_3 = .3520$	$S_{18} = .3374$ $S_6 = .3684$
$(-\log \bar{X}_{15}) - (-\log \bar{X}_3) = 0.25$	$(-\log \bar{X}_{18}) - (-\log \bar{X}_6) = 0.04$
$t_{.975} = \pm 0.226$ d.f. = 31	$t_{.80} = \pm 0.075$
∴ reject H_o	∴ accept H_o
One week after treatment	
$H_o: \mu_{\bar{X}_{21}} - \mu_{\bar{X}_3} = 0$	$H_o: \mu_{\bar{X}_{24}} - \mu_{\bar{X}_6} = 0$
$-\log \bar{X}_{21} = 5.82$ $-\log \bar{X}_3 = 5.75$	$-\log \bar{X}_{24} = 5.74$ $-\log \bar{X}_6 = 5.72$
$S_{21} = .4512$ $S_3 = .3849$	$S_{24} = .4293$ $S_6 = .3962$
$(-\log \bar{X}_{21}) - (-\log \bar{X}_3) = 0.07$	$(-\log \bar{X}_{24}) - (-\log \bar{X}_6) = 0.02$
$t_{.90} = \pm 0.132$ d.f. = 33	$t_{.80} = \pm 0.085$ d.f. = 33
∴ accept H_o	∴ accept H_o

TABLE 9 : COEFFICIENTS OF DETERMINATION ON TEST AND CONTROL SIDES BEFORE AND AFTER TREATMENT WITH SODIUM FLUORIDE OR SODIUM CHLORIDE

	Test Side			Control Side	
	Before	After		Before	After
$R^2_{3.12}$	0.1909		$R^2_{4.12}$	0.3250	
F	4.57		F	9.19	
$R^2_{6.123}$		0.0939	$R^2_{5.124}$		0.2894
F		1.3125	F		5.1579

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APPENDIX I

STANDARDIZATION OF ANTIMONY ELECTRODE

TABLE A : STANDARDIZATION OF Sb ELECTRODE AGAINST GLASS ELECTRODE USING p HYDRION BUFFERS

Solution number	(pH) X	(MV) Y	XY	X^2
3	4.20	230.2	966.84	17.64
4	4.40	244.7	1076.68	19.36
5	4.60	257.3	1183.58	21.16
6	4.80	270.1	1296.48	23.04
7	5.00	280.9	1404.50	25.00
8	5.20	293.2	1524.64	27.04
9	5.40	307.7	1661.58	29.16
10	5.60	320.2	1793.12	31.36
11	5.80	330.6	1917.48	33.64
12	6.00	345.1	2070.60	36.00
13	6.20	354.9	2200.38	38.44
14	6.40	369.0	2361.60	40.96
N = 12				
Totals	63.60	3603.9	19457.48	342.80

$$B = \frac{\Sigma XY - \frac{\Sigma X \Sigma Y}{n}}{\Sigma X^2 - \frac{(\Sigma X)^2}{n}} = \frac{19457.48 - \frac{63.6(3603.9)}{12}}{342.8 - \frac{(63.6)^2}{12}}$$

$$B = \frac{356.81}{5.72} = 62.379$$

$$A = \frac{\Sigma Y - B\,\Sigma X}{n} = \frac{3603.9 - 62.379(63.6)}{12}$$

$$A = -\frac{363.4}{12} = -30.28 \qquad Y = -30.28 + 62.379X$$

TABLE B : STANDARDIZATION OF Sb ELECTRODE AGAINST GLASS ELECTRODE USING KOLTHOFF VLEESCHHOUWER BUFFERS

Solution number	Glass X	Antimony Y	XY	X^2
1	4.00	235.0	940.0	16.00
2	4.30	254.0	1092.2	18.49
3	4.55	270.5	1230.8	20.70
4	4.80	282.0	1353.6	23.04
5	5.05	298.0	1504.9	25.50
6	5.30	311.0	1648.3	28.09
7	5.50	325.0	1787.5	30.25
8	5.90	348.0	2053.2	34.81
9	6.20	362.0	2244.4	38.44
10	6.70	390.0	2613.0	44.89
N = 10 Totals	52.30	3075.5	16467.7	280.21

$$B = \frac{\Sigma XY - \frac{\Sigma X \Sigma Y}{n}}{\Sigma X^2 - \frac{(\Sigma X)^2}{n}} = \frac{16467.7 - \frac{(52.3)(3075.5)}{10}}{280.21 - \frac{(52.3)^2}{10}}$$

$B = 57.04$

$$A = \frac{\Sigma Y - B\,\Sigma X}{n} = \frac{3075.5 - 57.04(52.3)}{10}$$

$A = 9.23$ $\quad Y = 9.23 + 57.04X \quad S_{X \cdot Y} = 0.026$

TABLE C : STANDARDIZATION OF Sb ELECTRODE AGAINST GLASS ELECTRODE USING MAC ILVAINE BUFFERS PLUS SODIUM LACTATE

Solution number	(pH) X	(MV) Y	XY	X^2
1	4.25	252.0	1071.00	18.06
2	5.50	323.0	1776.50	30.25
3	5.90	344.0	2029.60	34.81
4	6.12	357.0	2184.84	37.45
5	6.55	388.0	2541.40	42.90
6	6.90	405.0	2794.50	47.61
7	7.20	420.0	3024.00	51.84
N = 7 Totals	42.42	2489.0	15421.84	262.92

$$B = \frac{\Sigma XY - \frac{\Sigma X \, \Sigma Y}{n}}{\Sigma X^2 - \frac{(\Sigma X)^2}{n}} = \frac{15421.84 - \frac{(42.42)(2489.0)}{7}}{262.92 - \frac{(42.42)^2}{7}}$$

$$B = 57.75$$

$$A = \frac{\Sigma Y - B\,\Sigma X}{n} = \frac{2489.0 - (57.75)(42.42)}{7}$$

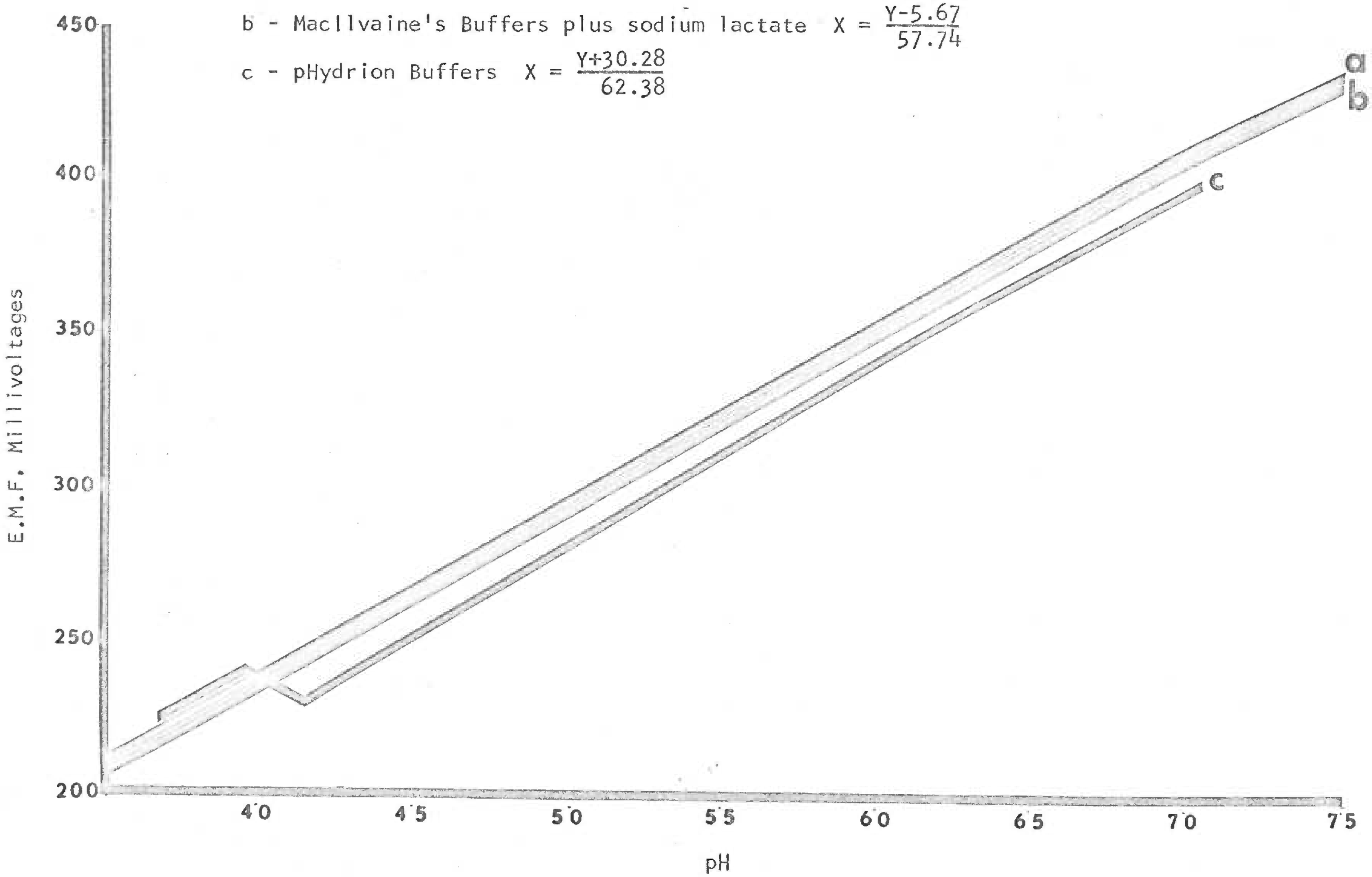
$A = 5.67$ $\qquad Y = 5.67 + 57.74\ X$ $\qquad S_{X \cdot Y} = .039$

Figure A: LINEAR REGRESSION OF THE ANTIMONY ELECTRODE E.M.F. MILLIVOLTAGES AND pH

a - Kolthoff Vleeschhouwer Buffers $X = \frac{Y-9.23}{57.04}$

b - MacIlvaine's Buffers plus sodium lactate $X = \frac{Y-5.67}{57.74}$

c - pHydrion Buffers $X = \frac{Y+30.28}{62.38}$



APPENDIX II

COMPARISON OF THE TEST AND CONTROL SIDES BEFORE TREATMENT WITH SODIUM FLUORIDE OR SODIUM CHLORIDE

TABLE D: COMPARISON OF TEST AND CONTROL SIDES BEFORE APPLICATION OF SODIUM FLUORIDE OR SODIUM CHLORIDE with respect to carious tooth surfaces present

Ident. number	Test Side Y_1	Control Side Y_2	Difference Y_{1-2}	$Y_{1-2} - \bar{Y}_{1-2}$	$(Y_{1-2} - \bar{Y}_{1-2})^2$
1	4	1	3	3.36	11.29
4	0	0	0	.36	.13
5	10	2	8	8.36	69.89
6	1	8	-7	-6.64	44.09
7	0	0	0	.36	.13
8	6	9	-3	-2.64	6.97
9	5	10	-5	-4.64	21.53
10	9	7	2	2.36	5.57
11	1	0	1	1.36	1.85
12	0	2	-2	-1.64	2.69
13	6	7	-1	- .64	.41
14	2	7	-5	-4.64	21.53
15	0	2	-2	-1.64	2.69
16	9	17	-8	-7.64	58.37
17	9	2	7	7.36	54.17
18	5	0	5	5.36	28.73
20	4	7	-3	-2.64	6.97
21	8	4	4	4.36	19.01
22	0	0	0	.36	.13
24	10	20	-10	-9.64	92.93
25	16	11	5	5.36	28.73
26	2	1	1	1.36	1.85
28	0	0	0	.36	.13
30	0	0	0	.36	.13
31	10	14	-4	-3.64	13.25
32	0	1	-1	- .64	.41
33	1	0	1	1.36	1.85
34	17	20	-3	-2.64	6.97
35	3	2	1	1.36	1.85

TABLE D: COMPARISON OF TEST AND CONTROL SIDES BEFORE APPLICATION OF SODIUM FLUORIDE OR SODIUM CHLORIDE with respect to carious tooth surfaces present *

Ident. number	Test Side Y_1	Control Side Y_2	Difference Y_{1-2}	$Y_{1-2}-\bar{Y}_{1-2}$	$(Y_{1-2}-\bar{Y}_{1-2})^2$
36	4	1	3	3.36	11.29
37	8	7	1	1.36	1.85
38	5	5	0	.36	.13
40	4	7	-3	-2.64	6.97
42	4	2	2	2.36	5.57
43	12	10	2	2.36	5.57
45	3	4	-1	- .64	.41
46	0	0	0	.36	.13
47	21	20	1	1.36	1.85
48	6	7	-1	- .64	.41
49	1	0	1	1.36	1.85
50	2	1	1	1.36	1.85
51	6	11	-5	-4.64	21.53
Totals	214	229	-15		563.66
Means	5.09	5.45	- .36		3.7

H_0: $\mu_{\bar{Y}_1} - \mu_{\bar{Y}_2} = 0$ d.f. = 41 $t_{.90} = 1.302$

$1.302 = \frac{\bar{Y}_{1-2}}{3.7}\sqrt{42}$ $\bar{Y}_{1-2} = \pm 0.743$

∴ accept the hypothesis; not significantly different.

*See Table P for definition of notations.

TABLE E : COMPARISON OF TEST AND CONTROL SIDES BEFORE APPLICATION OF SODIUM FLUORIDE OR SODIUM CHLORIDE with respect to total tooth surfaces present

Ident. number	Test Side Z_1	Control Side Z_2	Difference Z_{1-2}	$Z_{1-2}-\bar{Z}_{1-2}$	$(Z_{1-2}-\bar{Z}_{1-2})^2$
1	64	59	5	4.833	23.358
4	64	64	0	.167	.028
5	64	64	0	.167	.028
6	50	59	-9	9.167	84.034
7	64	64	0	.167	.028
8	64	64	0	.167	.028
9	64	59	5	4.833	23.358
10	60	64	-4	4.167	17.364
11	64	64	0	.167	.028
12	59	54	5	4.833	23.358
13	59	59	0	.167	.028
14	54	59	-5	5.167	26.698
15	59	64	-5	5.167	26.698
16	64	64	0	.167	.028
17	64	59	5	4.833	23.358
18	64	64	0	.167	.028
20	59	59	0	.167	.028
21	59	59	0	.167	.028
22	64	64	0	.167	.028
24	54	59	-5	5.167	26.698
25	64	59	5	4.833	23.358
26	64	64	0	.167	.028
28	49	49	0	.167	.028
30	64	64	0	.167	.028
31	59	59	0	.167	.028
32	64	64	0	.167	.028
33	64	59	5	4.833	23.358
34	64	64	0	.167	.028
35	64	64	0	.167	.028

TABLE E: COMPARISON OF TEST AND CONTROL SIDES BEFORE APPLICATION OF SODIUM FLUORIDE OR SODIUM CHLORIDE with respect to total tooth surfaces present *

Ident. number	Test Side Z_1	Control Side Z_2	Difference Z_{1-2}	$Z_{1-2}-\bar{Z}_{1-2}$	$(Z_{1-2}-\bar{Z}_{1-2})^2$
36	64	64	0	.167	.028
37	64	64	0	.167	.028
38	54	54	0	.167	.028
40	59	64	-5	5.167	26.698
42	64	64	0	.167	.028
43	54	49	5	4.833	23.358
45	64	64	0	.167	.028
46	64	64	0	.167	.028
47	59	64	-5	5.167	26.698
48	54	49	5	4.833	23.358
49	64	64	0	.167	.028
50	64	59	5	4.833	23.358
51	64	64	0	.167	.028
Totals	2565	2558	7		445.838
Means	61.071	60.905	0.167		S^2 10.87 S 3.3

H_o: $\mu\bar{Z}_1 - \mu\bar{Z}_2$ d.f. = 41 $t_{.90} = 1.302$

$$1.302 = \frac{\bar{Z}_{1-2}}{3.3}\sqrt{42} \qquad \bar{Z}_{1-2} = \pm 0.663$$

∴ accept the hypothesis; not significantly different.

*See Table P for definition of notations.

TABLE F : COMPARISON OF TEST AND CONTROL SIDES BEFORE APPLICATION OF SODIUM FLUORIDE OR SODIUM CHLORIDE with respect to resting state acid production

Ident. number	Test Side $X_1(10^{-7})$	Control Side $X_4(10^{-7})$	Difference $X_{1-4}(10^{-7})$	$X_{1-4}-\bar{X}_{1-4}$	$(X_{1-4}-\bar{X}_{1-4})^2$
1	1.027	1.492	-.465	-.738	.5446
4	1.461	1.280	.181	-.092	.0085
5	1.173	4.218	-3.045	-3.318	11.0091
6	1.205	1.126	.079	-.194	.0376
7	1.064	1.473	-.409	-.682	.4651
8	.631	.876	-.245	-.518	.2683
9	5.166	4.522	.644	.371	.1376
10	2.910	3.819	-.909	-1.182	1.3971
11	.686	.561	.125	-.148	.0219
12	1.892	2.156	-.264	-.537	.2884
13	1.999	1.493	.506	.233	.0543
14	.906	.639	.267	-.006	.0000
15	29.633	19.370	10.263	9.990	99.8001
16	2.140	2.922	-.782	-1.055	1.1130
17	.700	.486	.214	-.059	.0035
18	4.140	4.710	-.570	-.843	.7106
20	.653	.871	-.218	-.491	.2411
21	1.448	1.458	-.010	-.283	.0801
22	3.263	2.266	.997	.724	.5242
24	5.564	3.910	1.654	1.381	1.9072
25	1.766	2.119	-.353	-.626	.3919
26	3.339	3.118	.221	-.052	.0027
28	1.571	1.236	.335	.062	.0038
30	1.005	1.505	-.500	-.773	.5975
31	3.127	2.388	.739	.466	.2172
32	10.456	6.461	3.995	3.722	13.8533
33	1.088	1.435	-.347	-.620	.3844
34	1.716	1.375	.341	.068	.0046

TABLE F: COMPARISON OF TEST AND CONTROL SIDES BEFORE APPLICATION OF SODIUM FLUORIDE OR SODIUM CHLORIDE with respect to resting state acid production (Continued)*

Ident. number	Test Side $X_1 (10^{-7})$	Control Side $X_4 (10^{-7})$	Difference $X_{1-4} (10^{-7})$	$X_{1-4} - \bar{X}_{1-4}$	$(X_{1-4} - \bar{X}_{1-4})^2$
35	1.018	.425	.593	.320	.1024
36	2.711	3.211	-.500	-.773	.5975
37	2.507	2.979	-.472	-.745	.5550
38	1.972	1.440	.532	.259	.0671
40	.995	.522	.473	.200	.0400
42	2.213	1.764	.449	.176	.0310
43	4.073	3.883	.190	-.083	.0069
45	.881	1.282	-.401	-.674	.4543
46	1.050	3.206	-2.156	-2.429	5.9000
47	1.684	2.160	-.476	-.749	.5610
48	2.436	1.677	.759	.486	.2362
49	1.875	1.027	.848	.575	.3306
50	1.216	1.361	-.145	-.418	.1747
51	2.264	2.858	-.594	-.867	.7517
Totals	118.624	107.080	11.544		143.8761
Means	2.823	2.550	.275		S^2 3.5092 S 1.8733

$H_o : \mu_{\bar{X}_1} - \mu_{\bar{X}_4} = 0$ d.f. = 41 $t_{.90} = 1.302$

$1.302 = \frac{\bar{X}_{1-4}}{1.87}\sqrt{42}$ $\bar{X}_{1-4} = \pm 0.376$

$\bar{X}_1 - \bar{X}_4 = 0.275$ ∴ accept H_o; not statistically significant

*See Table P for definition of notations.

TABLE G : COMPARISON OF TEST AND CONTROL SIDES BEFORE APPLICATION OF SODIUM FLUORIDE OR SODIUM CHLORIDE with respect to sugar stimulated acid production *

Ident. number	Test Side $X_2(10^{-7})$	Control Side $X_5(10^{-7})$	Difference $X_{2-5}(10^{-7})$	$X_{2-5}-\bar{X}_{2-5}$	$(X_{2-5}-\bar{X}_{2-5})^2$
1	2.339	5.342	-3.003	-.219	.0480
4	43.238	32.241	10.997	13.781	189.9160
5	27.486	9.776	17.710	20.494	420.0040
6	7.540	8.909	-1.369	1.415	2.0022
7	18.844	27.256	-8.412	-5.628	31.6744
8	22.689	34.716	-12.027	-9.243	85.4330
9	31.356	25.214	6.142	8.926	79.6735
10	14.323	15.847	-1.524	1.260	1.5876
11	6.066	12.654	-6.588	-3.804	14.4704
12	9.032	6.653	2.379	5.163	26.6566
13	13.067	9.085	3.982	6.766	45.7788
14	20.170	37.170	-17.000	-14.216	202.0947
15	66.577	51.032	15.545	18.329	335.9522
16	14.620	15.061	-.441	2.343	5.4896
17	28.815	13.945	14.870	17.654	311.6637
18	13.364	14.803	-1.439	1.345	1.8090
20	12.719	20.225	-7.506	-4.722	22.2973
21	7.830	11.932	-4.102	-1.318	1.7371
22	37.477	32.255	5.222	8.006	64.0960
24	43.466	42.913	.553	3.337	11.1356
25	57.966	75.477	-17.511	-14.727	216.8845
26	46.466	20.424	26.042	28.826	830.9383
28	7.930	7.876	.054	2.838	8.0542
30	19.122	22.088	-2.966	-.182	.0331
31	74.400	99.611	-25.211	-22.427	502.9703
32	25.355	21.939	3.416	6.200	38.4400
33	8.158	5.846	2.312	5.096	25.9692
34	32.623	50.856	-18.233	-15.449	238.6716

TABLE G : COMPARISON OF TEST AND CONTROL SIDES BEFORE APPLICATION OF SODIUM FLUORIDE OR SODIUM CHLORIDE with respect to sugar stimulated acid production (Continued)

Ident. number	Test Side $X_2(10^{-7})$	Control Side $X_5(10^{-7})$	Difference $X_{2-5}(10^{-7})$	$X_{2-5}-\bar{X}_{2-5}$	$(X_{2-5}-\bar{X}_{2-5})^2$
35	14.883	28.325	-13.442	-10.658	113.5930
36	12.453	9.203	3.250	6.034	36.4092
37	25.244	27.305	-2.061	.723	.5227
38	23.807	22.773	1.034	3.818	14.5771
40	19.580	14.246	5.334	8.118	65.9019
42	37.712	45.255	-7.543	-4.759	22.6481
43	20.595	77.514	-56.919	-54.135	2930.5982
45	54.722	48.858	5.864	8.648	74.7879
46	20.869	11.354	9.515	12.299	151.2654
47	49.244	76.577	-27.333	-24.549	602.6534
48	48.088	59.055	-10.967	-8.183	66.9615
49	7.821	8.705	-.884	1.900	3.6100
50	29.907	25.303	4.604	7.388	54.5825
51	32.033	41.289	-9.256	-6.472	41.8868
Totals	1109.996	1226.908	-116.912		7895.4786
Means	26.428	29.212	-2.784		S^2 192.5726 S 13.877

$H_o: \mu_{\bar{X}_2} - \mu_{\bar{X}_5} = 0$ d.f. = 41 $t_{.90} = 1.302$

$$1.302 = \frac{\bar{X}_{2-5}}{13.877}\sqrt{42} \qquad \bar{X}_{2-5} = \pm 2.788$$

$\bar{X}_2 - \bar{X}_5 = -2.784$ ∴ accept H_o.

*See Table P for definition of notations.

TABLE H : COMPARISON OF TEST AND CONTROL SIDES BEFORE APPLICATION OF SODIUM FLUORIDE OR SODIUM CHLORIDE with respect to the difference between the resting state and sugar stimulated acid production*

Ident. number	Test Side $X_3(10^{-7})$	Control Side $X_6(10^{-7})$	Difference $X_{3-6}(10^{-7})$	$X_{3-6}-\bar{X}_{3-6}$	$(X_{3-6}-\bar{X}_{3-6})^2$
1	1.312	3.832	-2.520	.537	.2884
4	41.777	30.961	10.816	13.873	192.4601
5	26.313	5.558	20.755	23.812	567.0113
6	6.335	7.783	-1.448	1.609	2.5889
7	17.780	25.787	-8.007	-4.950	24.5025
8	22.058	33.840	-11.782	-8.725	76.1256
9	26.240	20.692	5.548	8.605	74.0460
10	11.413	12.028	-.615	2.442	5.9634
11	5.380	12.093	-6.713	-3.656	13.3663
12	7.140	4.497	2.643	5.700	32.4900
13	11.068	7.592	3.476	6.533	42.6801
14	19.264	36.531	-17.267	-14.210	201.9241
15	36.944	31.653	5.291	8.348	69.6891
16	12.480	12.139	.341	3.398	11.5464
17	28.115	13.459	14.656	17.713	313.7504
18	9.224	10.093	-.869	2.188	4.7873
20	12.066	19.354	-7.288	-4.231	17.9014
21	6.382	10.474	-4.092	-1.035	1.0712
22	34.214	29.989	4.225	7.282	53.0275
24	37.902	39.003	-1.101	1.956	3.8259
25	56.200	73.358	-17.158	-14.101	198.8382
26	43.127	17.306	25.821	28.878	833.9389
28	6.359	6.638	-.279	2.778	7.7173
30	18.117	20.583	-2.466	.591	.3493
31	71.273	97.233	-25.960	-22.903	524.5474
32	14.899	15.478	-.579	2.478	6.1405
33	7.070	4.411	2.659	5.716	32.6727
34	30.907	49.481	-18.574	-15.517	240.7773

TABLE H : COMPARISON OF TEST AND CONTROL SIDES BEFORE APPLICATION OF SODIUM FLUORIDE OR SODIUM CHLORIDE with respect to the difference between the resting state and sugar stimulated acid production

Ident. number	Test Side $X_3(10^{-7})$	Control Side $X_6(10^{-7})$	Difference $X_{3-6}(10^{-7})$	$X_{3-6}-\bar{X}_{3-6}$	$(X_{3-6}-\bar{X}_{3-6})^2$
35	13.865	27.900	-14.035	10.978	120.5165
36	9.742	5.992	3.750	6.807	46.3352
37	22.737	24.326	-1.589	1.468	2.1550
38	21.835	21.333	.502	3.559	12.6665
40	18.585	13.724	4.861	7.918	62.6947
42	35.499	43.491	-7.992	-4.935	24.3542
43	16.522	73.631	-57.109	-54.052	2921.6187
45	53.841	47.576	6.265	9.322	86.8997
46	19.819	8.148	11.671	14.728	216.9140
47	47.560	74.417	-26.857	-23.800	566.4400
48	45.652	57.378	-11.726	-8.669	75.1516
49	5.946	7.678	-1.732	1.325	1.7556
50	28.691	23.942	4.749	7.806	60.9336
51	29.769	38.431	-8.662	-5.605	31.4160
Totals	991.422	1119.813	-128.391		7783.8788
Means	23.605	26.662	-3.057	s^2	189.851
				s	13.778

$H_o : \mu_{\bar{X}_3} - \mu_{\bar{X}_6} = 0$ d.f. = 41 $t_{.95} = 1.682$

$$1.682 = \frac{X_{3-6}}{13.778}\sqrt{42} \qquad \bar{X}_{3-6} = \pm 3.576$$

$\bar{X}_3 - \bar{X}_6 = -3.057$ ∴ accept H_o

*See Table P for definition of notations.

APPENDIX III

STATISTICAL ANALYSES

TABLE I : TEST OF THE HYPOTHESIS $\mu_{\bar{X}_9} - \mu_{\bar{X}_3} = 0$*

Ident. number	- log X_9	$X_9 - \bar{X}_9$	$(X_9 - \bar{X}_9)^2$	- log X_3	$X_3 - \bar{X}_3$	$(X_3 - \bar{X}_3)^2$
1	7.56	.97	.9409	6.88	1.14	1.2996
4	6.36	-.23	.0529	5.38	-.36	.1296
5	7.49	.90	.8100	5.58	-.16	.0256
6	6.43	-.16	.0256	6.20	.46	.2116
7	6.21	-.38	.1444	5.75	.01	.0001
8	7.09	.50	.2500	5.66	-.08	.0064
9	6.55	-.04	.0016	5.58	-.16	.0256
10	7.28	.69	.4761	5.94	.20	.0400
11	6.57	-.02	.0004	6.27	.53	.2809
12	6.59	00	0000	6.15	.41	.1681
13	6.44	-.15	.0225	5.96	.22	.0484
14	6.82	.23	.0529	5.72	-.02	.0004
15	6.46	.13	.0169	5.43	-.31	.0961
16	6.21	.38	.1444	5.91	.17	.0289
17	6.94	.35	.1225	5.55	-.19	.0361
18	5.80	.79	.6241	6.04	.30	.0900
20	5.93	.66	.4356	5.92	.18	.0324
21	6.47	.12	.0144	6.20	.46	.2116
22	5.97	.62	.3844	5.47	-.27	.0729
24	6.88	.29	.0841	5.42	-.32	.1024
25	6.01	.58	.3364	5.25	-.49	.2401
26	6.75	.16	.0256	5.36	-.38	.1444
28	6.07	.52	.2704	6.20	.46	.2116
30	5.99	.60	.3600	5.74	00	0000
31	6.08	.51	.2601	5.15	-.59	.3481
32	8.62	2.03	4.1209	5.83	.09	.0081
33	6.77	.18	.0324	6.15	.41	.1681

TABLE I: TEST OF THE HYPOTHESIS $\mu_{\bar{X}_9} - \mu_{\bar{X}_3} = 0$ (Continued)

Ident. number	- log			- log		
	X_9	$X_9 - \bar{X}_9$	$(X_9 - \bar{X}_9)^2$	X_3	$X_3 - \bar{X}_3$	$(X_3 - \bar{X}_3)^2$
34	6.58	.01	.0001	5.51	-.23	.0529
35	6.82	.23	.0529	5.86	.12	.0144
36	6.60	.01	.0001	6.01	.27	.0729
37	6.53	.06	.0036	5.64	-.10	.0100
38	6.56	.03	.0009	5.66	-.08	.0064
40	6.97	.38	.1444	5.73	-.01	.0001
42	5.94	.65	.4225	5.45	-.29	.0841
43	6.76	.17	.0289	5.78	.04	.0016
45	6.59	00	0000	5.27	-.47	.2209
46	6.82	.23	.0529	5.70	-.04	.0016
47	6.31	.28	.0784	5.32	-.42	.1764
48	6.29	.30	.0900	5.34	-.40	.1600
49	7.06	.47	.2209	6.23	.49	.2401
50	6.31	.28	.0784	5.54	-.20	.0400
51	6.40	.19	.0361	5.53	-.21	.0441
Totals	276.88		11.2196	241.26		5.1526
Means	6.59			5.74		
Variance			.2736			.1256
Standard Deviation			.5224			.3535

*See Table Q for definition of notations.

H_o: $\mu_{X_9} - \mu_{X_3} = 0$ df = 82 $t_{99} = 2.390$ $S_p = .447$

$$2.39 = \frac{\bar{X}_{9-3}}{.447}\sqrt{21} \qquad S_p^2 = \frac{41(.274) + 41(.126)}{82} = 0.20$$

$\bar{X}_{9-3} = \pm 0.286$

$\bar{X}_9 - \bar{X}_3 = 6.59 = 5.74 = 0.85$ ∴ reject the hypothesis

TABLE J : TEST OF THE HYPOTHESIS $\mu_{\bar{X}_{12}} - \mu_{\bar{X}_6} = 0$*

Ident. number	- log X_{12}	$X_{12} - \bar{X}_{12}$	$(X_{12} - \bar{X}_{12})^2$	-log X_6	$X_6 - \bar{X}_6$	$(X_6 - \bar{X}_6)^2$
1	6.04	.24	.0576	6.41	.69	.4761
4	5.14	-.66	.4356	5.51	-.21	.0441
5	5.74	-.06	.0036	6.25	.53	.2809
6	6.51	.71	.5041	6.11	.39	.1521
7	5.87	.07	.0049	5.59	-.13	.0169
8	6.05	.25	.0625	5.47	-.25	.0625
9	5.80	00	.0000	5.69	-.03	.0009
10	5.90	.09	.0081	5.92	.20	.0400
11	5.78	-.02	.0004	5.92	.20	.0400
12	6.39	.59	.3481	6.35	.63	.3969
13	6.32	.52	.2704	6.12	.40	.1600
14	5.90	.10	.0100	5.44	-.28	.0784
15	6.10	.30	.0900	5.50	-.22	.0484
16	6.01	.21	.0441	5.92	.20	.0400
17	5.70	-.10	.0100	5.87	.15	.0225
18	5.51	-.29	.0841	5.99	.27	.0729
20	5.39	-.41	.1681	5.71	-.01	.0001
21	5.92	.12	.0144	5.99	.27	.0729
22	6.08	.28	.0784	5.52	-.20	.0400
24	5.52	-.28	.0784	5.41	-.31	.0961
25	5.31	-.49	.2401	5.13	-.59	.3481
26	5.77	-.03	.0009	5.76	.04	.0016
28	5.47	-.33	.1089	6.18	.46	.2116
30	5.65	-.15	.0225	5.69	-.03	.0009
31	5.74	-.06	.0036	5.01	-.71	.5041
32	5.63	-.17	.0289	5.81	.09	.0081
33	6.43	.63	.3969	6.36	.64	.4096
34	5.66	-.14	.0196	5.31	-.41	.1681
35	5.73	-.07	.0049	5.55	-.17	.0289
36	5.84	.04	.0016	6.22	.50	.2500

TABLE J: TEST OF THE HYPOTHESIS $\mu_{\bar{X}_{12}} - \mu_{\bar{X}_6} = 0$ (Continued)

Ident. number	-log X_{12}	$X_{12} - \bar{X}_{12}$	$(X_{12} - \bar{X}_{12})^2$	-log X_6	$X_6 - \bar{X}_6$	$(X_6 - \bar{X}_6)^2$
37	5.91	.11	.0121	5.61	-.11	.0121
38	5.82	.02	.0004	5.67	-.05	.0025
40	5.87	.07	.0049	5.86	.14	.0196
42	5.32	-.48	.2304	5.36	-.36	.1296
43	6.36	.56	.3136	5.13	-.59	.3481
45	5.52	-.28	.0784	5.32	-.40	.1600
46	6.54	.74	.5476	6.09	.37	.1369
47	5.07	-.73	.5329	5.13	-.59	.3481
48	5.36	-.44	.1936	5.24	-.48	.2304
49	5.87	.07	.0049	6.12	.40	.1600
50	5.81	.01	.0001	5.62	-.10	.0100
51	5.64	-.16	.0256	5.42	-.30	.0900
Totals	243.99		5.0452	240.28		5.7200
Means	5.81			5.72		
Variance			.1230			.1395
Standard Deviation			.3507			.3735

*See Table Q for definition of notations.

$H_o: \mu_{\bar{X}_{12}} - \mu_{\bar{X}_5} = 0$ d.f. = 82 $t_{80} = .848$

$S_p^2 = \frac{41(.1230) + 41(.1395)}{82} = 0.1312$

$S_p = 0.3622$

$.848 = \frac{\bar{X}_{12-6}}{0.362} \sqrt{21}$ $\bar{X}_{12-6} = \pm 0.0670$

$\bar{X}_{12} - \bar{X}_6 = -5.80 + 5.72 = -0.08$ which is significant

$t_{.90} = 1.296$

$1.296 = \frac{\bar{X}_{12-6}}{0.361} \sqrt{21}$ $\bar{X}_{12-6} = \pm 0.102$

$\bar{X}_{12} - \bar{X}_6 = -0.08$ which is insignificant.

TABLE K : TEST OF THE HYPOTHESIS $\mu_{\bar{X}_{15}} - \mu_{\bar{X}_3} = 0$*

Ident. number	- log X_{15}	$X_{15} - \bar{X}_{15}$	$(X_{15} - \bar{X}_{15})^2$	- log X_3	$X_3 - \bar{X}_3$	$(X_3 - \bar{X}_3)^2$
1	7.95	-1.90	3.6100	6.88	1.08	1.1664
4	6.54	-.49	.2401	5.38	-.42	.1764
5	6.14	-.09	.0081	5.58	-.22	.0484
6	6.65	-.60	.3600	6.20	.40	.1600
7	5.75	.30	.0900	5.75	-.05	.0025
8	6.02	.03	.0009	5.66	-.14	.0196
9	5.56	.49	.2401	5.58	-.22	.0484
10	5.78	.27	.0729	5.94	.14	.0196
11	6.90	-.85	.7225	6.27	.47	.2209
12	6.24	-.19	.0361	6.15	.35	.1225
13	6.29	-.24	.0576	5.96	-.16	.0256
14	6.61	-.56	.3136	5.72	-.08	.0064
15	5.85	-.20	.0400	5.43	-.37	.1369
21	5.91	.14	.0196	6.20	.40	.1600
22	5.69	.34	.1156	5.47	-.33	.1089
28	5.40	.65	.4225	6.20	.40	.1600
30	5.63	.42	.1764	5.74	-.06	.0036
33	5.90	.15	.0225	6.15	.35	.1225
34	5.46	.59	.3481	5.51	-.29	.0841
35	6.18	-.13	.0169	5.86	.06	.0036
36	6.05	00	0000	6.01	.21	.0441
37	5.63	.42	.1764	5.64	-.16	.0256
38	5.21	.84	.7056	5.66	-.14	.0196
40	6.60	-.55	.3025	5.73	-.07	.0049
42	5.86	.19	.0361	5.45	-.35	.1225
43	5.81	.24	.0576	5.78	-.02	.0004
45	6.38	-.33	.1089	5.27	-.53	.2809
46	6.41	-.36	.1296	5.70	-.10	.0100
48	5.56	.49	.2401	5.34	-.46	.2116

TABLE K : TEST OF THE HYPOTHESIS $\mu_{\bar{X}_{15}} - \mu_{\bar{X}_3} = 0$ (Continued)

Ident. number	- log X_{15}	$X_{15} - \bar{X}_{15}$	$(X_{15} - \bar{X}_{15})^2$	- log X_3	$X_3 - \bar{X}_3$	$(X_3 - \bar{X}_3)^2$
49	5.82	.23	.0529	6.23	-.43	.1849
50	6.25	-.20	.0400	5.54	.26	.0676
51	5.76	.29	.0841	5.53	-.27	.0729
Totals	193.79		8.8473	185.51		3.8413
Means	6.05			5.80		
Variance			.2854			.1239
Standard Deviation			.5343			.3520

*See Table Q for definition of notations.

H_0: $\mu_{\bar{X}_{15}} - \mu_{\bar{X}_3} = 0$ d.f. = 62 $t_{.99} = 2.39$

$$S_p^2 = \frac{31(.2854) + 31(.1239)}{62} = .2046$$

$S_p = 0.4523$

$$2.39 = \frac{\bar{X}_{15-3}}{.452} \sqrt{16} \qquad \bar{X}_{15-3} = \pm\, 0.270$$

$6.05 - 5.80 = 0.25$ ∴ accept at 99% level

$t_{.975} = 2.0$

$$2.0 = \frac{\bar{X}_{15-3}}{.452} \sqrt{16} \qquad \bar{X}_{15-3} = \pm\, 0.226$$

$6.05 - 5.80 = 0.25$ ∴ reject at 97.5% level

TABLE L: TEST OF THE HYPOTHESIS $\mu_{\bar{X}_{18}} - \mu_{\bar{X}_6} = 0$*

Ident. number	- log X_{18}	$X_{18} - \bar{X}_{18}$	$(X_{18} - \bar{X}_{18})^2$	- log X_6	$X_6 - \bar{X}_6$	$(X_6 - \bar{X}_6)^2$
1	5.91	.10	.0100	6.41	.64	.4096
4	6.17	.36	.1296	5.51	-.26	.0676
5	5.75	-.06	.0036	6.25	.48	.2304
6	6.06	.25	.0625	6.11	.34	.1156
7	5.41	-.40	.1600	5.59	-.18	.0324
8	5.68	-.13	.0169	5.47	-.30	.0900
9	6.47	.66	.4356	5.69	-.08	.0064
10	5.76	-.05	.0025	5.92	.15	.0225
11	5.88	.07	.0049	5.92	.15	.0225
12	6.01	.20	.0400	6.35	.58	.3364
13	6.18	.37	.1369	6.12	.35	.1225
14	5.69	-.12	.0144	5.44	-.33	.1089
15	6.17	.36	.1296	5.50	-.27	.0729
21	5.84	.03	.0009	5.99	.22	.0484
22	5.74	-.07	.0049	5.52	-.25	.0625
28	5.78	-.03	.0009	6.18	.41	.1681
30	5.41	-.40	.1600	5.69	-.08	.0064
33	5.89	.08	.0064	6.36	.59	.3481
34	5.28	-.53	.2809	5.31	-.46	.2116
35	6.64	.83	.6889	5.55	-.22	.0484
36	6.15	.34	.1156	6.22	.45	.2025
37	5.67	-.14	.0196	5.61	-.16	.0256
38	5.76	-.05	.0025	5.67	-.10	.0100
40	5.97	.16	.0256	5.86	.09	.0081
42	5.52	-.29	.0841	5.36	-.41	.1681
43	5.18	-.63	.3969	5.13	-.64	.4096
45	5.81	00	0000	5.32	-.45	.2025
46	6.19	.38	.1444	6.09	.32	.1024
48	5.24	-.57	.3249	5.24	.53	.2809

TABLE L : TEST OF THE HYPOTHESIS $\mu_{\bar{X}_{18}} - \mu_{\bar{X}_6} = 0$ (Continued)

Ident. number	- log X_{18}	$X_{18} - \bar{X}_{18}$	$(X_{18} - \bar{X}_{18})^2$	- log X_6	$X_6 - \bar{X}_6$	$(X_6 - \bar{X}_6)^2$
49	5.71	-.10	.0100	6.12	.35	.1225
50	5.73	-.08	.0064	5.62	.15	.0225
51	5.48	-.33	.1089	5.42	.35	.1225
Totals	186.13		3.5283	184.54		4.2084
Means	5.81			5.77		
Variance			.1138			.1357
Standard Deviation			.3374			.3684

*See Table Q for definition of notations.

$H_o: \mu_{\bar{X}_{18}} - \mu_{\bar{X}_6} = 0$ d.f. = 62 $t_{.80} = 0.848$

$$S_p^2 = \frac{31(.1138) + 31(.1357)}{62} = .1247$$

$S_p = .353$

$$0.848 = \frac{\bar{X}_{18-6}}{.353}\sqrt{16} \qquad \bar{X}_{18-6} = \pm\, 0.075$$

5.81 - 5.77 = 0.04 therefore accept H_o.

TABLE M : TEST OF THE HYPOTHESIS $\mu_{\bar{X}_{21}} - \mu_{\bar{X}_3} = 0$*

Ident. number	- log			- log		
	X_{21}	$X_{21} - \bar{X}_{21}$	$(X_{21} - \bar{X}_{21})^2$	X_3	$X_3 - \bar{X}_3$	$(X_3 - \bar{X}_3)^2$
1	6.29	.47	.2209	6.88	1.13	1.2769
4	5.93	.11	.0121	5.38	-.37	.1369
5	6.41	.59	.3481	5.58	-.17	.0289
6	6.01	.19	.0361	6.20	.45	.2025
7	6.12	.30	.0900	5.75	0	0000
8	5.77	-.05	.0025	5.66	-.09	.0081
9	6.42	.60	.3600	5.58	-.17	.0289
10	5.59	-.23	.0529	5.94	.19	.0361
11	6.92	1.10	1.2100	6.27	.52	.2704
12	6.54	.72	.5184	6.15	.40	.1600
13	5.89	.07	.0049	5.96	.21	.0441
17	5.96	.14	.0196	5.55	-.20	.0400
18	5.85	.03	.0009	6.04	.29	.0841
20	5.55	-.27	.0729	5.92	.17	.0289
21	5.75	-.07	.0049	6.20	.45	.2025
22	5.21	-.61	.3721	5.47	-.28	.0784
24	5.69	-.13	.0169	5.42	-.33	.1089
25	5.42	-.40	.1600	5.25	-.50	.2500
26	5.53	-.29	.0841	5.36	-.39	.1521
28	6.20	.38	.1444	6.20	.45	.2025
30	6.34	.52	.2704	5.74	-.01	.0001
31	5.51	-.31	.0961	5.15	-.60	.3600
33	5.99	.17	.0289	6.15	.40	.1600
34	5.45	-.37	.1369	5.51	-.24	.0576
35	5.57	-.25	.0625	5.86	.11	.0121
40	6.51	.69	.4761	5.73	-.02	.0004
42	5.38	-.44	.1936	5.45	-.30	.0900
43	5.51	-.31	.0961	5.78	.03	.0009
45	5.69	-.13	.0169	5.27	-.48	.2304

TABLE M : TEST OF THE HYPOTHESIS $\mu_{\bar{X}_{21}} - \mu_{\bar{X}_3} = 0$ (Continued)

Ident. number	- log X_{21}	$X_{21} - \bar{X}_{21}$	$(X_{21} - \bar{X}_{21})^2$	- log X_3	$X_3 - \bar{X}_3$	$(X_3 - \bar{X}_3)^2$
46	5.86	.04	.0016	5.70	-.05	.0025
47	4.91	-.91	.8281	5.32	-.43	.1849
48	5.08	-.74	.5476	5.34	-.41	.1681
49	5.60	-.22	.0484	6.23	.48	.2304
51	5.39	-.43	.1849	5.53	-.22	.0484
Totals	197.84		6.7198	195.52		4.8860
Means	5.82			5.75		
Variance			.2036			.1481
Standard Deviation			.4512			.3849

*See Table Q for definition of notations.

H_o: $\mu_{\bar{X}_{21}} - \mu_{\bar{X}_3} = 0$ N = 34 d.f. = 66 $t_{.90} = 1.296$

$S_p = .4193$ $S_p^2 = \frac{33(.2036) + 33(.1481)}{66} = .1758$

$1.296 = \frac{\bar{X}_{21-3}}{.419}\sqrt{17}$ $\bar{X}_{21-3} = \pm 0.132$

5.82 - 5.75 = .07 which is insignificant ∴ accept the hypothesis.

TABLE N : TEST OF THE HYPOTHESIS $\mu_{\bar{X}_{24}} - \mu_{\bar{X}_6} = 0$*

Ident. number	-log X_{24}	$X_{24} - \bar{X}_{24}$	$(X_{24} - \bar{X}_{24})^2$	-log X_6	$X_6 - \bar{X}_6$	$(X_6 - \bar{X}_6)^2$
1	5.99	.25	.0625	6.41	.69	.4761
4	5.66	-.08	.0064	5.51	-.21	.0441
5	5.82	.08	.0064	6.25	.53	.2809
6	5.95	.21	.0441	6.11	.39	.1521
7	5.92	.18	.0324	5.59	-.13	.0169
8	6.55	.81	.6561	5.47	-.25	.0625
9	6.39	.65	.4225	5.69	-.03	.0009
10	5.18	-.56	.3136	5.92	.20	.0400
11	6.45	.71	.5041	5.92	.20	.0400
12	6.44	.70	.4900	6.35	.63	.3969
13	6.30	.56	.3136	6.12	.40	.1600
17	6.14	.40	.1600	5.87	.15	.0225
18	5.13	-.61	.3721	5.99	.17	.0289
20	5.63	-.11	.0121	5.71	.01	.0001
21	5.80	.06	.0036	5.99	.17	.0289
22	5.55	-.19	.0361	5.52	-.20	.0400
24	5.63	-.11	.0121	5.41	-.31	.0961
25	5.44	-.30	.0900	5.13	-.59	.3481
26	5.42	-.32	.1024	5.76	.04	.0016
28	6.08	.34	.1156	6.18	.46	.2116
30	5.79	.05	.0025	5.69	-.03	.0009
31	5.41	-.33	.1089	5.01	-.71	.5041
33	6.24	.50	.2500	6.36	.64	.4096
34	5.21	-.53	.2809	5.31	-.41	.1681
35	5.79	.05	.0025	5.55	-.17	.0289
40	5.73	-.01	.0001	5.86	.14	.0196
42	5.63	-.11	.0121	5.36	-.36	.1296
43	5.14	-.60	.3600	5.13	-.59	.3481
45	5.41	-.33	.1089	5.32	-.40	.1600

TABLE N : TEST OF THE HYPOTHESIS $\mu_{\bar{X}_{24}} - \mu_{\bar{X}_6} = 0$ (Continued)

Ident. number	- log X_{24}	$X_{24} - \bar{X}_{24}$	$(X_{24} - \bar{X}_{24})$	- log X_6	$X_6 - \bar{X}_6$	$(X_6 - \bar{X}_6)^2$
46	5.74	00	0000	6.09	.37	.1369
47	5.95	.21	.0441	5.13	-.59	.3481
48	4.80	-.94	.8836	5.24	-.48	.2304
49	5.71	-.03	.0009	6.12	.40	.1600
51	5.22	-.52	.2704	5.42	-.30	.0900
Totals	195.24		6.0806	194.49		5.1825
Means	5.74			5.72		
Variance			.1843			.1570
Standard Deviation			.4293			.3962

*See Table Q for definition of notations.

H_o: $\mu_{X_{24}} - \mu_{X_6} = 0$ $\quad$ N = 34 $\quad$ d.f. = 66 $\quad$ $t_{.80} = 0.848$

$$S_p^{\,2} = \frac{33(.1843) + 33(.1570)}{66} = 0.1706$$

$S_p = 0.413$

$$0.848 = \frac{\bar{X}_{24-6}}{.413}\sqrt{17} \qquad \bar{X}_{24-6} = \pm\, 0.085$$

5.74 - 5.72 = 0.02 ∴ we accept the hypothesis.

TABLE 0 : MULTIPLE REGRESSION: TEST AND CONTROL SIDES AFTER SODIUM FLUORIDE TREATMENT

Test Side	
Regression coefficients	
Variable	
1	0.00004
2	-.01111
3	.40687
Coefficient of determination	0.0939
Intercept	-2.90069
Standard error	0.51825
F Value	1.3125
Control Side	
Regression coefficients	
Variable	
1	0.00099
2	-.01111
3	0.40687
Coefficient of determination	0.2894
Intercept	-3.92164
Standard Error	0.30344
F Value	5.1579

TABLE O : CORRELATION COEFFICIENTS FOR MULTIPLE REGRESSION AND MULTIPLE CORRELATION ANALYSIS *

	X_1	X_2	X_3	X_4	X_5	X_6
X_1	1.00000	-0.19366	0.38075	0.56617	0.28682	0.13875
X_2	-.19366	1.00000	.12055	-.04434	.12633	-.13920
X_3	.38075	.12055	1.00000	.78831	.46669	.25420
X_4	.56617	-.04434	.78831	1.00000	.51620	.31170
X_5	.28682	.12633	.46669	.51620	1.00000	.21115
X_6	.13875	-.13920	.25420	.31170	.21115	1.00000

*See Table R for definition of notations.

APPENDIX IV

NOTATIONS

Table P : NOTATIONS USED IN STUDIES COMPARING THE TEST AND CONTROL SIDES BEFORE TREATMENT WITH SODIUM FLUORIDE OR SODIUM CHLORIDE

X_1 - Resting state hydrogen ion concentrations on the test side

X_2 - Sugar-stimulated hydrogen ion concentrations on the test side

X_3 - Differences between resting state and sugar-stimulated hydrogen ion concentrations on the test side

X_4 - Resting state hydrogen ion concentrations on the control side

X_5 - Sugar-stimulated hydrogen ion concentrations on the control side

X_6 - Differences between resting state and sugar-stimulated hydrogen ion concentrations on the control side

Y_1 - Number of carious surfaces on the test side

Y_2 - Number of carious surfaces on the control side

Z_1 - Total number of tooth surfaces on the test side

Z_2 - Total number of tooth surfaces on the control side

Table Q: NOTATIONS USED IN TESTS OF DIFFERENCES BETWEEN MEANS

	TEST SIDE			CONTROL SIDE		
	Resting State Hydrogen Ion Concentration	Sugar-stimulated Hydrogen Ion Concentration	Difference	Resting State Hydrogen Ion Concentration	Sugar-stimulated Hydrogen Ion Concentration	Difference
Before NaF-NaCl	X_1	X_2	X_3	X_4	X_5	X_6
8hr post NaF-NaCl	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}
3-4 days post NaF-NaCl	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}
1 wk post NaF-NaCl	X_{19}	X_{20}	X_{21}	X_{22}	X_{23}	X_{24}
2wks post NaF-NaCl	X_{25}	X_{26}	X_{27}	X_{28}	X_{29}	X_{30}
1 mo post NaF-NaCl	X_{31}	X_{32}	X_{33}	X_{34}	X_{35}	X_{36}

TABLE R: NOTATIONS USED IN MULTIPLE REGRESSION ANALYSES

X_1 - Total number of carious surfaces

X_2 - Total number of tooth surfaces

X_3 - Differences between resting state and sugar-stimulated hydrogen ion concentrations on the test side before treatment with NaF

X_4 - Differences between resting state and sugar-stimulated hydrogen ion concentrations on the control side before treatment with NaCl

X_5 - Differences between resting state and sugar-stimulated hydrogen ion concentrations on the control side eight hours post-treatment with NaCl

X_6 - Differences between resting state and sugar-stimulated hydrogen ion concentrations on the test side eight hours post-treatment with NaF