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SALIVA CHARACTERISTICS, DIET AND CARIORECEPTIVITY IN DENTAL STUDENTS

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Abstract

Background and aims. *The use of sugar by dental plaque microorganisms leads to acid formation from the bacteria metabolism, which determines a decrease of pH onto teeth surfaces. The value of the critical pH is 5.2-5.5. We aimed to evaluate the capacity of patients to change their diet towards caries prevention after acknowledging the values of saliva parameters (pH, buffer capacity).*

Material and methods. *A group of 52 subjects were clinically examined according to the International Caries Assessment and Detection System protocol. They were required to complete a diet questionnaire and salivary tests were made for the oral mucosa hydration level, pH, buffer capacity, salivary flow rate at rest and upon stimulation. 4 pre-calibrated 6th year students and 2 dentists performed the tests and the ICDAS examination. One week after the tests, the subjects were asked to complete the diet questionnaire again. The studied group consisted of students aged between 23-26 years, randomly selected among 6th year students of the Faculty of Dentistry from Cluj-Napoca.*

Results and Discussion. *The mean DMF-S index was 18.39. Most of the patients (65%) had a DMF-S index between 9 and 21. Just 2.5% had an index of 3, which was the lowest value recorded. 5% of the patients had a DMFS of 35, which was the maximal value recorded. The distribution of DMF-S was normal. 50% of the patients had no active caries. Even though most subjects (19.23%) had a pH within the normal interval, most of them were at the bottom value of the interval (6.8). Most subjects had a pH of 6.4, which is moderately acid. The mean pH was 6.7, therefore, a moderately acid one. The Pearson correlation coefficient between DMFS and pH was 0.255.*

A mild negative correlation (-0.275) was found between the cariogenic food and buffer capacity. A week later we noticed a statistically significant decrease of cariogenic foods and drinks in students with acid pH and with low buffer capacity.

Conclusions. *A regular intake of cakes, bonbons and chocolate was reported by subjects who had a high DMF-S value and a low saliva buffer capacity. Only after the patients were aware of their caries risk, did they change their diet towards a non-cariogenic one, even though they had had the theoretical knowledge regarding caries prevention for at least 3 years. We conclude that the use of the chair-side salivary test should be highly recommended for cario-receptive patients.*

Keywords: caries experience, pH, buffering capacity of saliva, diet

Introduction

The use of sugars by dental plaque microorganisms leads to acid formation from the bacteria metabolism, which determines a decrease of the pH onto the teeth surfaces. The value of the critical pH is 5.2-5.5.

Previous studies have shown larger quantities and faster rates of acid production in caries-active individuals than that in caries-free individuals [1,2,3].

The natural remineralization process has been proved by the spontaneous disappearance of the white-spot lesions in some patients. A very reliable study observed for 6 years 72 white spot lesions and noted the disappearance of 51% of

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the lesions during this time-span [1].

The solutions formed by a weak acid and its salt with a strong base, or those solutions composed of a weak base and its salt with a strong acid, have the role of compensating large variations of the pH when limited quantities of acids of bases are added. They are characterized by two parameters:

1. the pH they are able to maintain;
2. the buffering capacity.

The quantitative assessment of resistance to pH changes is referred to as buffer capacity. There is reasonably strong evidence to indicate that the salivary buffering capacity protects the tooth from dental caries [4].

The pH is maintained at normal values by the tampon system carbonic acid/bicarbonate, or by the tampon-system primary phosphate/secondary phosphate. The salivary proteins contribute at maintaining constantly the salivary pH due to aminoacids (especially those with base-like characteristics).

A constantly low pH due to a smaller buffer-capacity increases the caries incidence. The pH and the buffer capacity depends on:

- sex and age: lower buffer capacity due to a lower salivary flow;
- diet: a diet rich in proteins and vegetables and poor in glucids increases the buffer capacity;
- medication, the stress changes the buffer capacity by reducing the salivary flow;
- smoking diminishes saliva buffer capacity by lowering the concentration of the $HCO3^-$ ion, which explains the increased number of caries in smokers.

The normal values of the pH are between 5.6 and 7.6. Under the critical pH of 5.5 calcium and phosphate ions are lost underneath the dental plaque; at a pH of 3.0 to 4.0 the surface of the tooth becomes rough and is etched.

Low buffering capacity is usually associated with caries development because of its impaired neutralization of plaque acids and reduced re-mineralization of early enamel lesions [5,6].

The bacterial plaque constantly builds-up on the surface of the teeth. It starts one hour after eating and if undisturbed it reaches a peak after 30 days. The frequent carbohydrate intake is a disruptive factor which breaks the normal ecological equilibrium of the bacterial plaque and selects a cariogenic one.

An association between low caries levels and high salivary buffering capacity has been also demonstrated [7,8]. Individuals with a high salivary buffer capacity are often caries-resistant.

We aimed to evaluate the capacity of the patients to change their diet towards caries prevention after acknowledging the values of saliva parameters (pH, buffer capacity). Therefore we chose 6th year dental students as patients, assuming they have the theoretical knowledge regarding a healthy diet but not applying it probably due to lack of motivation.

Material and methods

A group of 52 subjects were clinically examined according to International Caries Assessment and Detection System protocol. They were required to fill in a diet questionnaire and salivary tests were made for the oral mucosa hydration level, pH, buffer capacity, salivary flow rate at rest and upon stimulation. 4 pre-calibrated 6th year students and 2 dentists performed the tests and the ICDAS examination. One week after the tests, the subjects were asked to complete the diet questionnaire again.

The study group consisted of students aged between 23-26 years, randomly selected among 6th year students of the Faculty of Dentistry from the University of Medicine and Pharmacy "Iuliu Haţieganu" from Cluj-Napoca.

All subjects voluntarily agreed to take part in this non-interventional study.

We used GC Saliva-Check Buffer kits (figure 1) which consist of: in vitro pH testing strips 5.0-8.0, cups for collecting saliva, standard pieces of paraffin for chewing in order to stimulate salivary flow, droppers, buffer-capacity testing strips.

Figure 1. Saliva check kit

Before performing the tests, the subjects were asked not to smoke, eat or drink anything, not to brush their teeth, nor to use mouthwash for at least one hour before the test.

A visual assessment of the hydration level of the oral mucosa was made by wiping off the lower lip mucosa and counting the time until the first saliva drops were produced by the minor salivary glands (figure 2). If that time span was longer than 60 seconds the subject was classified as low hydration level.

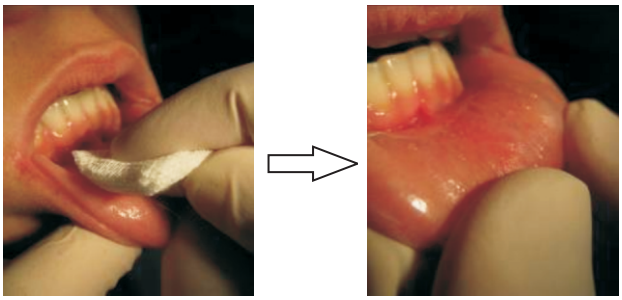

Figure 2. Visual assessment of the hydration level

In order to determine the consistency of saliva, we visually assessed the aspect of saliva on the mouth floor. According to the recommendations of GC®, we classified the subject as having one of the following types of saliva:

- sticky, thick (very high viscosity)
- aired with bubbles (high viscosity)
- water-like, clear (regular viscosity)

For measuring the pH we asked the subject to collect saliva into a designated cup. We dipped in the pH indicator paper for 10 seconds (figure 3), then we compared the strip with the available chart (figure 4). Reading the result was made before the drying of the strip in order to avoid false results. We cleaned and dried the cup for the next step of the test.

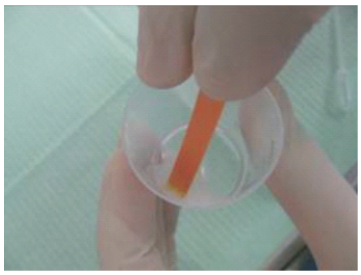

Figure 3. pH -strip imersed into saliva

Figure 4. Interpreting the pH

In order to stimulate the salivary flow, we asked the subject to chew for 5 minutes a standard paraffin piece (figure 5), asking him/her to collect in the cup all the saliva (figure 6). We recorded the volume of stimulated saliva (ignoring the foam).

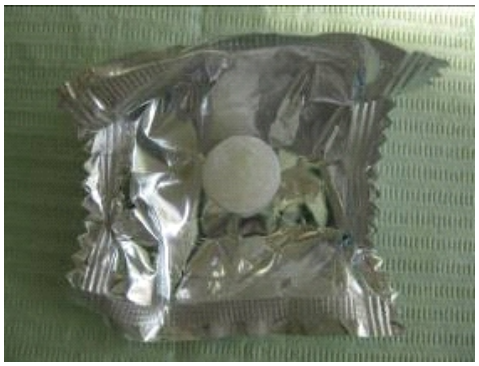

Figure 5. Standard paraffin piece from GC Saliva Check Buffer®

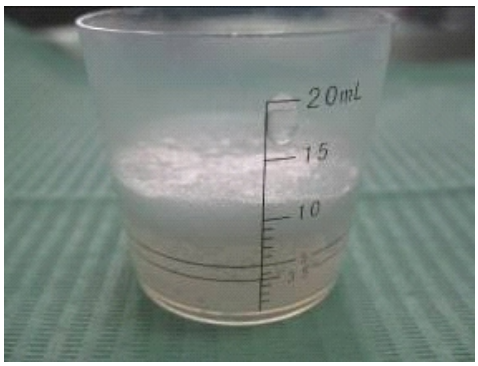

Figure 6. Evaluating the salivary flow

The normal value of salivary flow should be 1 ml/min.

For measuring the buffer-capacity of stimulated saliva we put a few drops of saliva on each of the 3 test areas, using the pipette and we absorbed the excess drops (figure 7). We read the test according to recommendations after 2 minutes, although the test areas started to change their color right away. According to the color of each area, a score was given and the result was obtained by summing up the 3 values:

- green = 4 points
- green/blue = 3 points
- blue = 2 points
- red/blue = 1 point
- Red= 0 points

According to the results the subjects were divided into 3 categories:

- 0-5 a very low buffer capacity;
- 6-9 low buffer capacity;
- 10-12 normal buffer capacity;

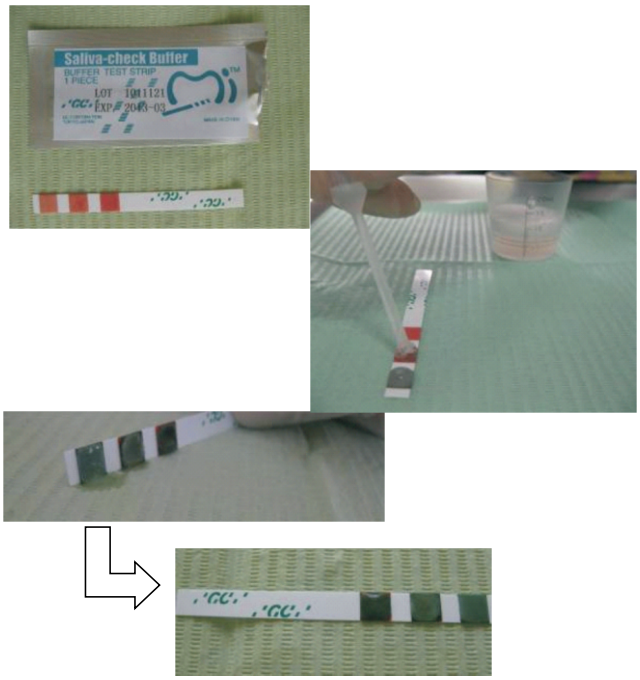

Figure 7. Saliva-Check buffer Strip

Based on the ICDAS chart, we calculated the DMFS index, meaning the number of decayed (D), missing (M) and filled (F) surfaces. The following were excluded: third molars, non-erupted teeth, congenitally missing or supernumerary, teeth removed for reasons other than caries, teeth restored for reasons other than caries and primary teeth retained with the permanent present [1].

For each subject we evaluated the O`Leary Plaque Index on 4 surfaces (buccal, oral, mesial and distal) for each tooth in a dichotomical manner (yes/no) [1].

The salivary tests and the diet questionnaires were repeated a week later for the patients having a moderately acid or very acid pH and/or low buffer capacity.

The data were collected and processed using the SPSS <<Statistical Package for the Social Sciences>> for descriptive and variance analysis.

Results and discussions

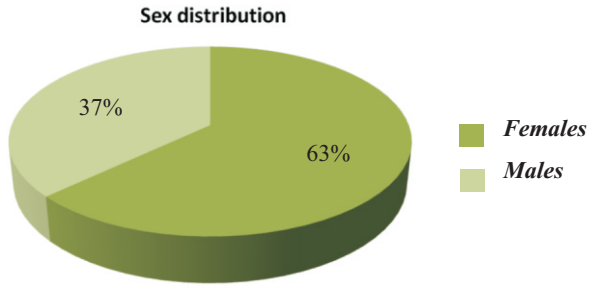

Figure 8. Sex distribution

The sex distributions were similar to those of the 6th dental students population (figure 8) with a mean age of 24.4 years.

The mean DMF-S index was 18.39 (table I).

Table I. Mean values of DMFS and of its components

DMFS	18.39
D1-2	6.42
D3-6	1.62
M	0.77
F3	11.0
F4	1.58

*D1-2= early stage caries
D3-6= cavitary caries
M = missing surfaces
F3 =tooth-colored restored surfaces
F4 = amalgam fillings

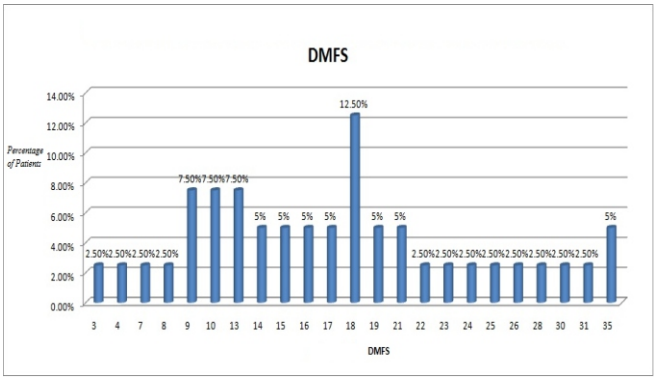

Figure 9. DMF-S distribution

65% of the patients had a DMF-S index between 9 and 21. Just 2.5% had an index of 3, which was the lowest value recorded. 5% of the patients had a DMFS of 35, which was the maximal value recorded. The distribution of DMF-S was normal (figure 9). 50% of the patients had no active caries (figure 10).

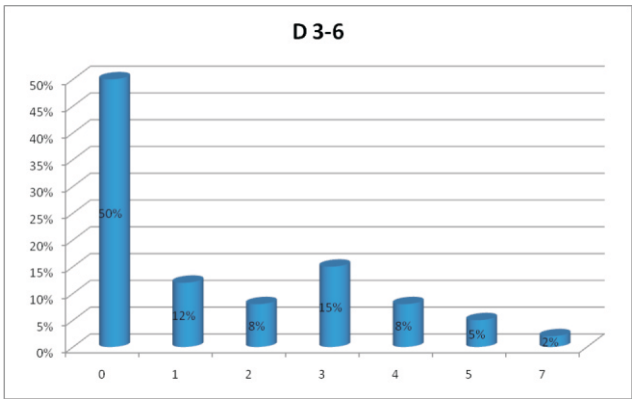

Figure 10. Active caries recorded (code 3 to 6 ICDAS)

We obtained a Pearson coefficient of correlation between DMFS and plaque index recorded by plaque disclosure tablets (figure 11) of 0.287.

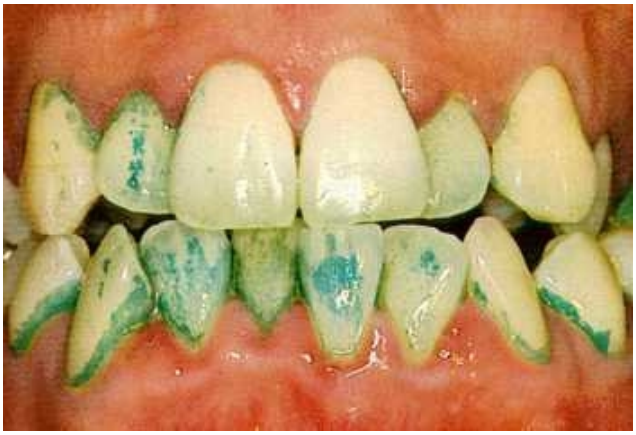

Figure 11. Plaque Index recorded by using plaque disclosure tablets

Most subjects had (53.85%) a normal pH (6.8–7.8); 38.46% had a moderately acidic pH (6.0–6.6), whereas just 7.69% had a very acidic pH (5.0–5.8)-figure 12.

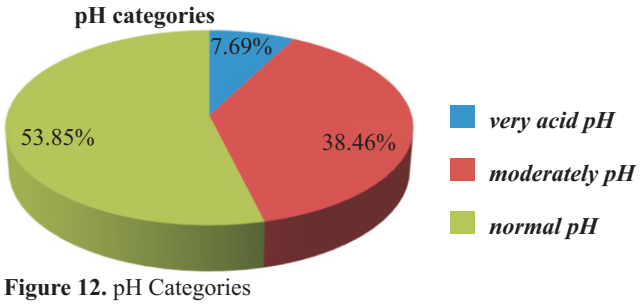

Figure 12. pH Categories

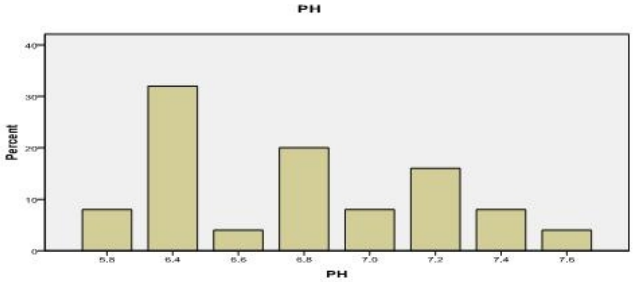

Figure 13. The Distribution of the pH

Even though most subjects (19.23%) had a pH within the normal interval, most of them were at the bottom value of the interval (6.8). Most subjects had a pH of 6.4, which is moderately acid (figure 13). The mean pH was 6.7, so a moderately acid one.

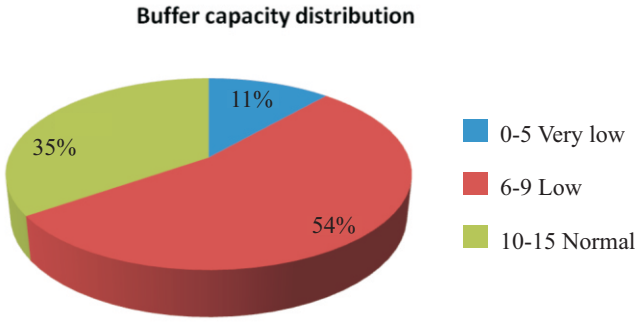

Figure 14. The distribution of the buffering capacity

The mean buffer capacity was 8, which is a low one and most of the subjects had a low buffering capacity (figure 14).

Initially, only 10% of the female students and 6.3% of the male students consumed daily non-cariogenic milk and dairy products. However, at the reevaluation after one week, amongst the patients with moderately and with very acid pH, 34.61% of the females and 30.76 of males consumed daily milk and its non-cariogenic derivatives.

The Pearson correlation coefficient between DMFS and pH was 0.255.

A mild negative correlation (-0.275) was found between cariogenic food and buffer capacity. A week later we noticed a statistically significant decrease of the cariogenic foods and drinks in students with acid pH and witha low buffer capacity.

We found mild correlations between saliva pH and buffer capacity, salivary flow and dental plaque (a moderately acid pH was correlated with a plaque index of 14 to 26)

The regular intake of cereals, sugar-free chewing-gum and fruits gem with butter, was highly correlated with a low DMF-S index (15 to 24) with no active cavitary caries.

The frequent intake of boiled vegetables and fresh fruits and rare intake of honey, was strongly correlated with a DMF-S index between 3 and 14.

The intake of cheese and fish correlated with a high buffer capacity, whereas the intake of cornflakes, potatoes, chocolate, bonbons and cookies strongly correlated with a low buffer capacity.

Smoking, mineral water and biscuit consumption was significantly associated with a moderate acidic pH, whereas milk, sugar-free yoghourt and sugar-free tea was associated with neutral values of the pH.

Due to the small number of patients, the correlation between plaque and DMFS and respectively between pH value and DMF-S was moderate.

We consider further studies on a larger sample would bring more information regarding saliva characteristics and caries experience.

We were not able to identify any correlation between saliva characteristics and diet, but we assume this is due to the small sample size compared to the high numbers of parameters from the diet questionnaire.

The saliva features varied according to stress, time of the day when it was collected etc, therefore further studies should consider these adjustment factors as well.

In the multiple-choice diet questionnaire we introduced foods with a high content of carbohydrates or in a sticky form. We also introduced non-cariogenic and cario-prophylactic foods and drinks, including those that stimulate the salivary flow through vigorous mastication.

Our results are in line with those published by the Maryland University, Baltimore, University of Göteborg, Sweden, the Eastman Dental Center, Rochester, N.Y. and with the data of ADA and WHO.

We included in the studied group only final year dental students because they have the theoretical knowledge regarding prevention of oro-dental diseases through a healthy diet. Yet they ate many cariogenic foods and drinks. Only after seeing the results of their salivary tests they significantly decreased the cariogenic food intake and increased the cario-prophylactic ones.

Conclusions

The most cariogenic foods were those in which sugar is combined with amidon in a sticky form such as cereal bars and biscuits.

If honey is consumed rarely or dissolved into coffee, milk or tea, it has a much smaller cariogenic effect compared to its intake combined with starch (bread).

Cheese and dairy product intake increase the saliva buffer capacity. Daily intake of milk and sugar-free dairy products increases the value of saliva pH and is correlated with a low DMF-S index.

Smoking and mineral water intake decrease the pH.

The regular intake of cakes, bonbons and chocolate was reported by the subjects who had a high DMF-S value and a low saliva buffer capacity. Only after the patients were aware of their caries risk, did they change their diet toward a non-cariogenic one, even though they had had the theoretical knowledge regarding caries prevention for at least 3 years.

We conclude that the use of a chair-side salivary test should be highly recommended for cario-receptive patients.

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