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Dynamics of Saliva Ph Change in Children Following Intake of Some Homeopathic Medications

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Abstract: ***Introduction: Many studies have shown that frequent use of conventional sugar-containing medications increases the risk for children`s oral health because of the simple carbohydrates and the low endogenious pH of these medicines. Nowadays, many parentschoose homeopathy over conventional medicinefor treatment and prophylaxis of their children, considering it as natural, effective and without side effects. However, their involvements as a risk factor for oral health stillremains an unexplored area. Material and Methods: The study includes 25 volunteer children.An in vitro saliva test with colored strips was used for four consecutive weeks and after intake of three homeopathic medications. The following entries were registered: baseline value, 15th, 30thand 60th minute following the intake of the respective homeopathic doses. During the first week, the study was carried out without intake of any homeopathic medicine. The data was subjected to statistical analysis. Results: There was a dropin salivary pH following intake of all homeopathic medicationsin all studied subjects. The pH reduction was most significant at 15th minute, and the average drop for the three homeopathic medications was - 0.85, 1.05, 0.96, respectively. On the 30th minute, the mean pH drop remained the highest for the second drug and on the 60th – for the first and second. Conclusion: There was a significant reduction in saliva pH by all studied patients after administration of each medicine. Many of the cases showed a drop below the critical value of 5.5. The values remained lower than the baseline even an hour following the intake.***

Keywords: saliva, homeopathy, children, salivary pH, dental caries

1. Introduction

Homeopathy is an alternative medical science, created at the end of the 18th century by Samuel Hahnemann. It is based on the 'principle of similarity' (similiasimilibuscurantur), i.e. like cures like ([1], [2], [3], [4]). This well-defined scientific system is among the most popular medicine approaches in modern times ([5]). Homeopathy is easily available (over the counter) and is prescribed for acute and chronic conditions, which makes it well accepted by parents and children([4]).

The preparation of homeopathic medicines includes a repeated dilution of a chosen substance in alcoholor distilled water, followed by forceful striking (ie. succussion) of the solution on an elastic object at every step of the dilution ([1], [3], [6]). This serial dilution, followed by succussion, is believed to increase the drug potency ([1]). Another technological process is the trituration - insolublesubstances are fine grinded and diluted with lactose. The final preparations are in liquid form or impregnated on sugar tablets ([3], [6]).

Homeopathic medicines may be in the form of pellets, tablets, powder or liquid.The liquid, or the mother tincture, consists of alcoholic extract of the specific drug and is generally placed under the tongue using a dropper ([5]). However, it should be not given to children since it contains alcohol ([5]). For infants they can be dissolved in water and administered with a dropper. Otherwise, they should be left in the mouth to dissolve without chewing ([5]). Children usually refuse to take medications because of their taste and the fact they need to be swallowed ([4]). This makes homeopathy easy to use with them because medications are usually in the form of sweet-tasting pellets, powders or liquids ([5]). They areprovided without prescription, made from natural extracts, are not toxic and have no potential side effects ([4]).

The role of sugar in dental caries etiology is clearly proven. A number of studies have focused attention on the sugar content of conventional liquid pediatric medications as potentially riskyfor the initiation and progression of a dental caries process with chronically ill children or suffering from frequently recurrent viral and bacterial infections ([7], [8], [9], [10], [11], [12], [13]). There are opinions that sugar content in homeopathic medicationscan also affects oral health ([4]). The increased frequency of intake ofboth prescribed and over-the-counter medicationsputs more and more children at risk of drug-related caries and should be considered a dental problem with public significance ([4]). Although some parents are aware of the sweetness and taste of homeopathic medications, they probably do not pay attention to the possible effects that these medications may have on their children`s oral health ([4]). All these facts determine the need for more in-depth studies on the effects of homeopathic medications on the oral environment and hence on oral health in childhood ([4]).

This study aims to evaluate the dynamics of pH values change in unstimulated saliva in children followingthe intakeof three commonly used homeopathic medications. The scientific hypothesis is that the intake of these homeopathic drugs shall result in a rapid drop insaliva pH and such drop remains within an hour time.

2. Material and Methods

The study includes 25 volunteer children. Criteria for inclusion are candidates to be completely healthy and not to be subject to any kind of medication that would change the saliva characteristics. A week prior to the study beginning, every volunteer underwent professional oral hygiene. Participants are given the same instructions for conducting oral hygiene and the same toothpaste is recommended. All volunteers have a sanitized dentition and no gingival inflammation. Prior to the study, its essence was explained to participants and their parentsso that they could providean informed consent.

The study was conducted once a week on a selected day for four consecutive weeks. To avoid the effects of circadian rhythms, the tests are done in the morning, at least one hour after breakfast and standard oral hygiene, between 8 and 11 am. Until the beginning and during the study, volunteers did not take any food or drink.

The unstimulated saliva is tested. The volunteers provide 1-2 spit samples in a sample cup. An in-vitro GC Saliva Check test is applied with a test strip that changes its color depending on the pH level. The saliva pH of each participant is measured then at baseline and at 15th, 30thand 60th minute after the homeopathic medication intake.

Three of the most frequently used homeopathic remedies were selected (according to our survey). These are homeopathic pellets to stimulate the immune system (№ 1); a homeopathic cough syrup (№ 2); and homeopathic granules with pain relief, soothing effect and often used in case of teetheruptiondiscomfort (№ 3). The first one contains animal derived sources - heart and liver and added sugars - sucrose and lactose. It is taken 2-3 times daily 15 minutes before or one hour after a meal. The second one contains components of plant and animal origin with added ethanol and sucrose. The intake is 3-5 times a day between meals. The third medication is chamomile-based and 3-5 granules are usually taken unlimited times during the day.

During the first week of the study, saliva pH was measured at the appropriate time intervals without medication intake. Thus, the saliva pH values serving as baseline control (control group- group 1) are determined. During the second week, on a given day, after measuring the baseline pH, one dose of pills of medication №1 is administered under the tongue until complete dissolution and then the pH is measured at the 15th, 30thand 60th minute. The measured saliva pH values following the administration of medication №1 constituted data defined as group 2. During the third week, on the given day, the same schedule was repeated as in the second week but with a dose of 15 ml of the homeopathic syrup (drug № 2). The registered values form data of group 3. On the designated day of the fourth week, 5 granules of the homeopathic preparation№ 3 were placed and kept under the tongue until complete dissolution. The measured saliva pH values form data of group 4. All results are documented in an individual card for each volunteer. Based on the knowledge of the saliva buffer capacity and the quick drop in pH below the critical values after intake of simple carbohydrates and its slow rise to baseline, requiring 15 to 40 minutes (demonstrated by the Stefan curve), we decided to register the change in saliva pH at the 15th, 30thand 60th minute. The objective is to represent in a better way the dynamics of pH change and its possible role as a risk factor for the development of dental caries based on the prolonged acidity that develops after taking a homeopathic medication.

The statistical processing of the results includes the determination of the number of existing drops in different groups, as well as their percentage to the total number in the groups. An ANOVA analysis is performed to verify the differences between the calculated mean values - relative proportion and mean value of the observed drop in saliva pH. For level of significance is adopted the p value - sig. <0.05. The data is analyzed using SPSS-19 software.

3. Results

Table 1 shows the relative proportion of individuals with a drop insaliva pH with and without a homeopathic medication intake and the corresponding minute of the measurement.

A decrease in saliva pH is observed in 100% of the volunteers at the 15th minute following the intake of each of the three tested homeopathic preparations, (group 2, 3 and 4, Table 1). A drop is reported in one subject from the control group (Table 1). The pH level following the intake of a homeopathic drug remained lower than the baseline value until the end of the study (60$^{th\ minute}$) in over 90% of the cases (Table 1). At 30$^{th\ minute}$, in onesubjectof group 2 is observed recovery of baseline pH, and at 60th minute in one subject of group 2 and 3 and twosubjects of group 3 such recovery of baseline pH is recorded.
Table 2 shows the mean value of saliva pH drop in each group at the measured minute intervals.

The highest mean drop in saliva pH, by 1.05, is recorded at 15th minute in group 3 (Table 2). This trend is retained for the same group together with group 2even at 60th minute, with a mean value of pH drop by 0.58 (Table 2).

Table 3 also shows the drop in saliva pH for the tested minute intervals, indicating the number (and relative proportion) of patients in the relevant group with saliva pH below 5.5 and in the range 5.5-6.0.

In group 3 at the 15th minute in 12 subjects is recorded meandrop in salivary pH below the critical value (5.5). At the 30th minute this number is 6. At the 60th minute no subjects with pH below the critical 5.5 are recorded. The highest incidence is of subjects with a pH drop in the range of 5.5-6 for group 4 at the 15th minute – 19 subjects. At the 30th minute they are almost equal for all groups – 11 in group 2 and 10 in group 3 and 4 (Table 3). At the 60th minute the most subjects with a pH drop between 5.5-6 are in group 3. In group 2, five volunteers showed minute drop in saliva pH below 5.5 at the 15th andone of the subjects - at the 30th minute. By twelve of the

subjectsin the same groupa drop to the range of 5.5-6 is recorded at the 15th minute and by eleven subjects - at the 30th minute. At the 60th minute, this number drops to six, with no registered values below 5.5. In group 4 at the 15th minute, three volunteers showed a drop below 5.5, though at the 60th minute none was in this range. In the same group at the 15th minute nineteen of the respondents had a saliva pH drop to 5.5-6 and on the 60th minute for four individuals it remained in the same range.

An ANOVA analysis was also used to verify the differences between the calculated mean values of saliva pH drop for the individual groups. The results obtained are shown in Table 4.

A significantdrop in mean saliva pH values is recorded in groups 2, 3 and 4 compared to the control group 1. The differences between these three groupsare statistically insignificant. In group 1, no drop under 6.0 is recorded and therefore it is excluded from the analysis.

The comparison in pairs between all groups, establishes the following dependencies: compared to group 1 in all other groupsis found statistically significant difference in the mean pH drop at the 15th minute ($p < 0.02$, Table 4). At the 30th and 60th minute the recorded mean values of pH drop in groups 2, 3 and 4 were statistically insignificant.

4. Discussion

The use of different types of conventional medications in childhood is widespread. This is demonstrated by numerous research articles and statistical studies around the world ([14], [15], [16]). It has been shown that these present a risk factor for the development of a dental caries process ([17], [18], [19], [20], [21]). The characteristics determining the medication cariesogenic potential are the sucrose content, the acidic nature of the drug and the individual salivation and salivary buffer capacity ([18]). Pierro et al. ([19]) mention the following characteristics as defining for the cariogenic potential of the drug: sugar content, frequency, dose, and route of administration.

The cariogenic potential of pediatric liquid drugs is due to the high concentration of fermentable carbohydrates and their acidity ([22]). 5% sucrose solution concentration is considered sufficient to form a cariogenic biofilm ([20]). Rekola ([23]) demonstratesin a study that sucrose or fructose-flavored syrups or a combination of fructose and sorbitol produce a noticeable and prolonged drop in plaque pH.

In a study by Pradhan et al. ([24]) it is concluded that the drop in salivary pH below the critical values takes place up to 6 minutes after rinsing with a 25% sucrose solution, making children taking sucrose medications prone to caries. As Bigeard et al. ([10]) claim, the increasing intake of prescripted drugs and the self-medication in developed countries puts a growing number of children at a risk of drug-related caries, which can be considered a public health problem.

Homeopathy is effective, relatively inexpensive, and patients are satisfied and rarely experience side effects ([25]). The convenient form of this type of medication and its sweet and pleasant taste make it suitable and well-received among children. There are still some rules that need to be followed by the administration of homeopathic remedies. They are prescribed with frequent intake - usually 3-4 times a day, and sometimes every two hours, on a regular basis and at night before bedtime ([4]). According to our results this will cause a drop insaliva pH and maintenance of a long-lasting acidity over a long period of time (Tables 2 and 3).The latter is further aggravated by the fact that the intake of a homeopathic medication should be at least 15 minutes before or after meals ([5]). During homeopathy treatment pastes without sweeteners, synthetic deodorants, bleaching agents, artificial colors or fragrances, detergents, mint ([5]) should be also used. The pastes should not contain fluorides ([5]).

Subramaniam and Kumar ([4]) suggest that the sugar content of homeopathic medical products can also affect oral health. Unlike pediatric liquid medications, sugar in homeopathy, according to the authors, can not be defined exactly as “hidden sugar”. It is rather “ignored”, “missed”, especially for chronically ill children. They have a higher sugar load and may be at a higher risk of developing caries from an early age. Five pellets, taken 4 times a day, contain a total of 1 gram of sugar ([26]).

Children are more prone to recurring colds, and many parents prefer homeopathic remedies to allopathic ones because of the absence of side effects ([4]). In many families, homeopathy is a choice of treatment in the case of recurrent illnesses and/or chronic ones (colds, runny nose, diarrhea, asthma, nausea and vomiting, headache, mucosal inflammation, colic in babies, etc.)([4]). Although parents are aware of the sweetness and taste of homeopathic medications, they probably do not pay attention to the possible effects that these granules may have on their children`s oral health ([4]).

A similar to our study tends to find a change in saliva pH after taking homeopathic drugs ([4]). Subramaniam and Kumar usechamomilla2x and arsenic 2x in their study and also find a significant drop in saliva pH (below the critical 5.5). The autors conclude that, depending on their composition, frequency of application, and length of therapy, the oral health of children undergoing regular homeopathic treatment should be monitored (4).For comparison between our study and Subramaniam and Kumar`s, we use the common chamomilla medication. The mean values of pH drop after use in their study are higher than those observed in ours: 0.96 (15th minute), 0.74 (30th minute), 0.51 (60th minute), while by Subramaniam and Kumar these are 1.72 (15th), 1.13 (30th), 0.88 (60th). Probably the reason is the different methodology used for collecting saliva samples and defining its pH. Both studies find a prolonged maintenance of low salivary pH <5.5. This may be a potential threat to the dentition (Table 3). There isa

predominance of demineralisation processes in the oral cavity which is a precondition for the initiation of a dental caries process.

There is a drop in saliva pH in 100% of the cases, and the values remain lower than the baseline even an hour following the intakein over 90% of the cases. This fact gives a reason to doubt a possible negative effect following the intake of certain homeopathic medications on the condition in the oral cavity.We also found cases where recovery of baseline pH is observed - in one case at 30th minute and in four–at 60th minute (Table 6 and 7). We suppose this is due to differences in speed, quantity, composition, and buffer capacity ofsaliva in different individuals.

The most significant reduction in pH we determined is that following intake of the homeopathic syrup. This fact we attribute to its high sucrose content, its low viscosity, and its acidic endogenous pH. These factors have been proven to be crucial in a number of similar studies of conventional medications and especially pediatric liquidones ([7]-[15], [17]-[23]). Low saliva pH levels are detected after the intake of homeopathicgranules and pellets. Perhaps the reason for this is the longer retention in the oral cavity until full absorption. These facts provide an idea for a future study in this field and on homeopathic medications - their composition, endogenous pH, titratable acidity, effects of different viscosity and form of medications.

We find a high incidence of pH drops below the critical 5.5 with most cases after homeopathic syrup use - almost 50% at the 15th minute.An alarming fact is also the failure of pH to recover itsbaseline values even 60 minutes after taking the medication, and in a significant number of cases the pH remains in the range of 5.5 to 6 (Tab. 3). We believe that, combined with poor eating habits, poor oral hygiene and/ or genetic predisposition, this could help increase the risk of dental caries.Thus we confirm the studied scientific hypothesis that the intake of these homeopathic drugs results in a rapid drop in salivary pH values and this drop remains within one hour.

5. Conclusion

The present study finds a significant drop in salivary pH following the intake of some homeopathic medications. Lower values remain in over 90% of the cases at the end of the first hour. This, along with the specific rules for the intake of homeopathic medications and their use in patient own discretion without prescription, makes them a factor in the risk assessment system for the development of a caries process, especially in childhood. Healthcare professionals and parents should apply prophylactic measures to limit the potential side effects that sugar-containing medications, including homeopathic ones, may have on the oral health of children.

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Table 1: Average proportion of individuals with a drop of salivary pH within an hour with and without intake of homeopathic medication

Groups	15th min.	30th min.	60th min.
	number %indiv.	number %indiv.	number % indiv.
Group 1 (control)	1–4, 0%	4 – 16, 0%	1 – 4, 0%
Group 2 (medication 1, pellets)	25 – 100%	24 – 96, 0%	24 – 96, 0%
Group 3 (medication 2, syrup)	25 – 100%	25 – 100%	24 – 96, 0%
Group 4 (medication 3, granules)	25 – 100%	25 – 100%	23 – 92, 0%
Total	76 – 76, 0%	78 – 78, 0%	72 – 72, 0%

Table 2: Average level of salivary pH drop in all groups in the relevant time intervals

Group	Average level pf salivary pH drop						
	Basic level	15th min.	Difference	30th min.	Difference	60th min.	Difference
Group 1	6.52	6.52	-0.00	6.51	-0.01	6.54	+0.02
Group 2	6.69	5.79	-0.90	5.94	-0.75	6.11	-0.58
Group 3	6.65	5.60	-1.05	5.78	-0.87	6.07	-0.58
Group 4	6.69	5.73	-0.96	5.95	-0.74	6.18	-0.51
Total	6.64	5.91	-0.73	6.05	-0.59	6.23	-0.41

Table 3: Number of individuals in the relevant groups with a drop of salivary pH under 5.5 and in the range 5.5-6 in different time intervals

Group	Drop 15th min.				Drop 30th min.				Drop 60th min.			
	under 5.5		5.5-6.0		under 5.5		5.5-6.0		under 5.5		5.5-6.0	
	n	%	n	%	n	%	n	%	n	%	n	%
1	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
2	5	20.0%	12	48.0%	1	4.0%	11	44.0%	0	0.0%	6	24.0%
3	12	48.0%	8	32.0%	6	24.0%	10	40.0%	0	0.0%	7	28.0%
4	3	12.0%	19	76.0%	1	4.0%	10	40.0%	0	0.0%	4	16.0%

Table 4: Difference in average levels of salivary pH drop between the groups in the relevant time intervals (p-value – Sig <0, 05)

Time interval	*Group*	*Compared with group*	*95% confidence interval*		*P**
			Lower limit	Upper limit	
15th minute	Group 1	Group 2 Group 3 Group 4	0, 113386 0, 257386 0, 169386	1, 294614 1, 438614 1, 350614	0, 020 0, 005 0, 012
	Group 2	Group 3 Group 4	-0, 083328 -0, 171328	0, 371328 0, 283328	0, 210 0, 624
	Group 3	Group 4	-0, 315328	0, 139328	0, 442
30th minute	Group 2	Group 3 Group 4	-0, 118565 -0, 254565	0, 295899 0, 159899	0, 396 0, 650
	Group 3	Group 4	-0, 341107	0, 069107	0, 190
60th minute	Group 2	Group 3 Group 4	-0, 172150 -0, 225823	0, 172150 0, 122200	1, 000 0, 554
	Group 3	Group 4	-0, 225823	0, 122200	0, 554

*Empirical level of scientific significance (ANOVA)

Table 5: pH changes within one hour – control

Subject	*Initial value*	*15th minute*	*30th minute*	*60thminutre*
1	7.2	7.2	7.0	7.2
2	6.4	6.2	6.2	6.2
3	6.8	6.8	6.8	6.8
4	7.0	7.0	7.0	7.0
5	7.0	7.0	7.0	7.0
6	7.2	7.0	7.2	7.2
7	6.8	6.8	6.8	6.8
8	6.4	6.4	6.4	6.4
9	6.2	6.2	6.0	6.2
10	6.8	6.8	6.8	6.8
11	6.8	6.8	6.8	6.8
12	6.2	6.2	6.2	6.2
13	6.2	6.2	6.2	6.2
14	6.4	6.4	6.4	6.4
15	6.0	6.0	6.0	6.0
16	7.0	7.0	6.8	7.0
17	6.8	6.8	6.8	6.8
18	6.4	6.4	6.4	6.4
19	6.4	6.4	6.6	6.6
20	5.8	6.0	6.0	6.0
21	6.0	6.0	6.0	6.0
22	6.0	6.0	6.0	6.0

23	6.4	6.4	6.4	6.6
24	6.8	6.8	6.8	6.8
25	6.0	6.2	6.2	6.2

Table 6: pH changes within one hour – pellets

Object	Initial value	15th minute	30th minute	60th minute
1	7.6	6.4	6.8	6.8
2	7.6	6.2	6.4	6.4
3	6.8	5.8	6.0	6.2
4	6.6	5.6	5.6	5.8
5	6.2	5.4	5.4	5.8
6	7.4	6.2	6.4	6.4
7	7.2	5.8	5.8	6.0
8	6.8	6.2	6.2	6.4
9	6.8	5.8	6.0	6.6
10	6.4	5.4	5.8	6.0
11	6.0	5.8	5.8	5.8
12	6.0	5.8	6.0	6.0
13	6.8	5.8	5.8	6.2
14	6.4	6.0	6.0	6.0
15	6.4	5.4	5.8	6.0
16	6.4	5.8	5.8	6.0
17	6.2	5.6	5.8	5.8
18	6.8	6.0	6.0	6.2
19	7.0	6.0	6.0	6.2
20	7.2	5.8	6.0	6.4
21	6.4	5.4	5.6	5.8
22	7.2	6.0	6.2	6.2
23	6.8	5.6	5.8	6.0
24	6.2	5.4	6.0	6.0
25	6.2	5.6	5.6	5.8

Table 7: pH changes within one hour – syrup

Object	Initial value	15th minute	30th minute	60th minute
1	7.0	5.4	5.8	6.8
2	7.0	5.0	5.2	5.6
3	6.8	5.6	5.6	5.8
4	6.4	5.4	5.8	5.8
5	6.8	5.4	5.4	6.0
6	6.8	5.2	5.4	5.8
7	6.6	6.0	6.0	6.2
8	5.8	5.4	5.6	5.6
9	6.2	5.2	5.2	5.8
10	6.2	5.8	5.8	6.0
11	7.2	5.8	6.0	6.4
12	7.0	6.0	6.2	6.2
13	7.6	6.0	6.4	6.8
14	7.0	5.4	5.8	6.0
15	6.2	5.8	6.0	6.2
16	6.8	5.8	5.8	6.0
17	7.0	5.8	6.2	6.2
18	6.0	5.2	5.2	5.8
19	6.2	5.8	6.0	6.0
20	6.4	6.0	6.0	6.0
21	6.8	5.4	5.4	6.0
22	6.4	5.6	5.8	6.0
23	6.8	5.4	5.8	6.2
24	7.0	6.2	6.4	6.4

25	6.2	5.4	5.6	6.0

Table 8: pH changes within one hour – granules

Object	Initial value	15th minute	30th minute	60th minute	
1	6.0	5.8	5.8	6.0	
2	7.6	6.4	6.8	6.8	
3	6.8	5.8	5.8	6.4	
4	6.8	5.4	5.8	6.0	
5	6.0	5.6	5.6	5.8	
6	7.4	5.8	6.0	6.4	
7	6.8	5.8	6.0	6.0	
8	7.4	6.0	6.0	6.4	
9	7.2	5.8	6.2	6.4	
10	7.0	5.8	6.4	6.4	
11	6.4	5.4	5.8	6.0	
12	6.8	5.8	6.0	6.2	
13	6.8	5.6	5.6	6.0	
14	6.2	5.0	5.4	5.8	
15	6.0	5.8	5.8	6.0	
16	6.4	5.6	5.8	5.8	
17	6.8	6.0	6.0	6.0	
18	6.6	5.8	6.0	6.2	
19	6.8	5.6	5.8	6.2	
20	6.0	5.6	5.8	5.8	
21	6.2	5.8	6.0	6.0	
22	7.2	5.8	6.2	6.8	
23	7.0	5.8	6.0	6.4	
24	6.2	5.6	6.0	6.0	
25	6.8	5.8	6.2	6.6	