
PHYSICO-CHEMICAL PROPERTIES OF THE ORAL FLUID AND THEIR IMPORTANCE IN ENSURING DENTAL HEALTH

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<https://doi.org/10.35339/ic.10.1.kot>

ABSTRACT

Background. The incidence of dental caries is high regardless of age and region. In this regard, there is a need to study the risk factors for the development of caries, in particular, the physico-chemical properties of oral fluid as one of them.

Aim of the research was to study the physico-chemical properties of oral fluid in children with caries of different levels of intensity and in caries free children.

Materials & Methods. An examination of 6-year-old children living in Bukovina was conducted. The following observation groups were selected: Group I – 69 children suffering from caries, and Group II – 26 caries free children. The rate of saliva secretion, physicochemical properties of oral fluid were studied: pH, viscosity, buffer capacity. The probability of the results was statistically assessed.

Results. In children with different levels of caries intensity, the level of salivation differed: for children with a high level of intensity was characterized by a low level of salivation, and for children with a low level – a high level of salivation. The viscosity of saliva was increased in children with caries of varying intensity. The buffer capacity of saliva was low in children with low levels of caries and very low in children with high levels of caries. PH in children with medium and high intensity was below normal. The analysis of the results of the Test of enamel resistance depending on caries activity showed that in children with a low level of intensity of caries, the enamel was conditionally resistant, and under the conditions of medium and high levels of intensity – the average structural and functional resistance of the enamel and the average acid resistance of the teeth.

Conclusions. Thus, in children suffering from caries with different levels of intensity, there are changes in the quantitative and qualitative parameters of the oral fluid, which lead to disorders of the homeostasis of the oral cavity and deepening of the pathological process in the hard tissues of the teeth.

Keywords: *caries, children, buffer capacity, level of salivation, pH.*

INTRODUCTION

The literature indicates that dental well-being is fundamental in maintaining the health of children in general [1]. The condition of the organs of the oral cavity depends on the balance in the microbial landscape, trace element balance, composition and properties of the oral fluid [2–3]. The first changes in the structure of the enamel already begin when the acidity of the oral fluid decreases, its viscosity increases, saliva secretion decreases, and the concentration of the mineralizing compo-

nent changes. In addition to the imbalance in the "enamel-saliva" system, more than 100 other factors lead to the development of caries [3–5]. They can be of different intensity and character, different variants of their interaction. A number of researchers assign a significant role to local risk factors for the development of dental diseases in children – thus, the specificity of dental plaque, local mechanisms of protection of the oral cavity, some quality indicators of oral fluid, the presence of bad habits [1–5].

The incidence of caries is high in hole world, in different parts of Ukraine in particular [2–6]. In this regard, there is a need to study the risk factors for the development of caries, in particular, the physico-chemical properties of oral fluid as one of them.

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The aim of the study – to evaluate the physical and chemical properties of oral fluid in children and to determine their role in ensuring of dental health.

Materials and Methods

To solve the goal, we examined 95 children aged 6 years living in Bukovyna. The following observation groups were selected: Group I – 69 children suffering from caries with different levels of intensity, and Group II – 26 caries free children.

Visual assessment of the volume of saliva secretion was carried out by observing after drying the appearance of drops of saliva near the small salivary glands on the mucous membrane of the lower lip. The level of natural salivation was assessed as normal when a drop of saliva appeared within 1 minute, low – more than 1 minute, and high – less than 30 seconds. The viscosity of saliva was also determined visually: significantly increased if saliva foams, increased – saliva foams, there are bubbles, normal – saliva is transparent and watery. The collected saliva was used for pH-metry and determination of the buffer capacity [7].

The hydrogen index of oral fluid (pH) (before eating) was determined using litmus paper with a graduated color scale (5.6–8.0). An indicator piece of paper was dipped into the tubes with unstimulated saliva for 10 seconds. The obtained pH data were compared with a standard color scale: red – 5.0–5.9; yellow – 6.0–6.7 and green – 6.8–7.8.

The buffer capacity of saliva was determined using special strip systems. With a pipette, saliva was applied to 3 test fields and after 3 minutes the change in color from green to red was evaluated. If the sum of points was 10–12, then the indicators were evaluated as normal, 6–9 – low, and up to 5 – very low [7].

To determine the resistance of tooth enamel to caries, the enamel resistance test (TER) according to Okushko V.R. and Kosareva L.I. was used [7]. The degree of enamel staining was assessed by comparing it with a color polygraphic 10-point scale. In accordance with the color of enamel staining, the following levels of enamel resistance were distinguished:

- high caries resistance of enamel (1–3 points) – pale blue coloring;
- moderate resistance of enamel (4–5 points) – blue staining;
- reduced enamel resistance to caries (6–7 points) – blue staining;
- very low enamel caries resistance (8–10 points) – dark blue staining.

The degree of probability of the obtained results was statistically evaluated in the case of normality of the distribution of both samples using the Student-Fisher test, in other cases – the U-Wilkson test for independent samples and the T-Wilkson test for dependent samples. Statistically evaluated the probability of the obtained results in the case of normal distribution of both samples by Student-Fisher test, in other cases - U-Wilkson for independent samples and T-Wilkson test for dependent samples using the program "STATISTICA 6.1" ("StatSoft, Inc", USA).

Results and Discussion

Changes in the composition and structure of oral fluid during pathological processes of the oral cavity, in particular when the hard tissues of the teeth are affected by caries, are unquestionable. After all, not only the level of acid-salt balance – pH, but also its mechanical and physico-chemical properties changes.

The amount of secreted saliva is an extremely important indicator, because the effectiveness of local protective properties depends on its volume. We determined changes in the level of salivation in 6-year-old children with different levels of caries intensity of temporary teeth (*Table 1*).

The normal level of salivation prevailed in children with low and medium caries intensity (in 34.78% and 52.17% of cases, respectively). A low level of salivation was characteristic of children with medium (in 58.33% of the examined) and high caries intensity (in 54.54% of children). As for the high level of salivation, it was found in 52.17% of children with low intensity of caries and 12.50% of children with medium intensity of caries. Caries free children have a high level of salivation.

Qualitative analysis of saliva showed an increase in its viscosity even at a low level of caries intensity of temporary teeth in 52.17% of children (*Table 2*). Predominance of increased viscosity of saliva contributes to reduced cleaning of the oral cavity from food residues, microorganisms and their decay products and, as a result, to a decrease in the resistance of enamel to the action of cariesogenic factors.

The buffer capacity of saliva is a property of the oral fluid, thanks to which neutralization of acids and alkalis is ensured. This indicator is considered as a protective mechanism during the action of acids on the hard tissues of the teeth, that is, it increases the resistance of enamel to caries. Thus, at a low level of disease intensity, the buffer capacity

of saliva was assessed as normal (in 39.13%) and low (in 52.17%), with medium and high caries intensity as low (in 54.16% and in 31.81%, respectively of those examined) and very low (in 33.33% and in 54.54%) (Table 3).

Under normal conditions, the pH of saliva is in the range of 6.4–7.3 [7]. The concentration of hydrogen ions affects the processes of mineralization and remineralization of enamel, microcirculation, activity of microflora, specific and nonspecific resistance of tissues of the oral cavity. Determination of the pH level of oral fluid in children showed that this value changes depending on the level of intensity of the disease. If at low intensity of caries no significant difference in the values of this indicator compared to dentally healthy children was found ($[6.75\pm0.01]$ and $[6.83\pm0.02]$, re-

spectively), then at medium and high intensity of caries its value probably decreased and were (6.28 ± 0.02) and (5.96 ± 0.01) units (Fig. 1).

In order to evaluate caries resistance of tooth enamel, we used the TER test. The analysis of the results depending on the caries activity showed that in children with a low level of caries intensity, the TER test is (2.89 ± 0.32) points, which is the extreme limit of the norm, and the enamel is assessed as conditionally resistant (Fig. 2). Under the conditions of an average level of caries intensity in children, the value of this indicator is equal to (4.02 ± 0.43) points, and under the conditions of a high level – (5.07 ± 0.24) points. The obtained data indicate the average structural and functional resistance of the enamel and the average acid resistance of the teeth.

Table 1. The level of saliva secretion in children of observation groups depending on the level of dental caries intensity

Level of saliva secretion	Level of dental caries intensity						Caries free children (n=26)	
	low (n=23)		middle (n=24)		high (n=22)			
	%	abs.	%	abs.	%	abs.	%	abs.
normal	34.78	8	29.17	7	22.72	5	11.54	3
low	13.04	3	58.33	14	54.54	12	-	-
high	52.17	12	12.50	3	22.72	5	88.46	23

Table 2. Salivary viscosity in children of observation groups depending on the level of dental caries intensity

Salivary viscosity	Level of dental caries intensity						Caries free children (n=26)	
	low (n=23)		middle (n=24)		high (n=22)			
	%	abs.	%	abs.	%	abs.	%	abs.
normal	34.78	8	29.17	7	22.72	5	76.92	20
increased	52.17	12	58.33	14	54.54	12	23.08	6
very high	13.04	3	12.50	3	22.72	5	-	-

Table 3. The buffer capacity of saliva in children of observation groups depending on the level of dental caries intensity

Buffer capacity	Level of dental caries intensity						Caries free children (n=26)	
	low (n=23)		middle (n=24)		high (n=22)			
	%	abs.	%	abs.	%	abs.	%	abs.
normal	39.13	9	12.50	3	13.63	3	76.92	20
low	52.17	12	54.16	13	31.81	7	23.07	6
very low	8.69	2	33.33	8	54.54	12	-	-

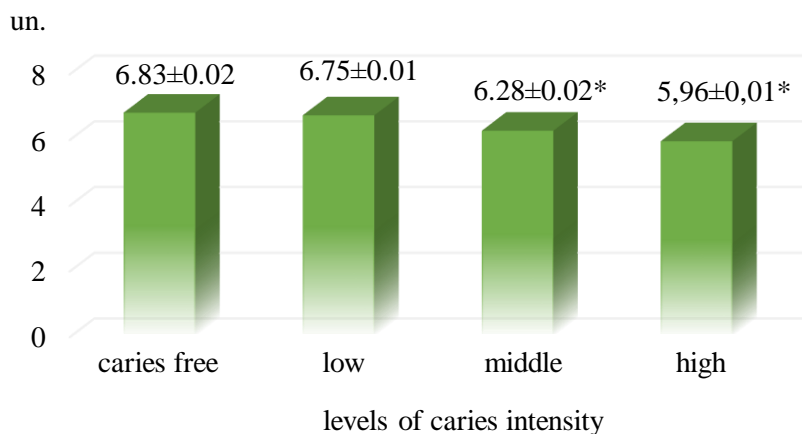


Fig. 1. PH of saliva in children of observation groups depending on the intensity level of dental caries.

Note: * – the difference between the indicators of caries free children and children with caries is significant ($p < 0.05$).

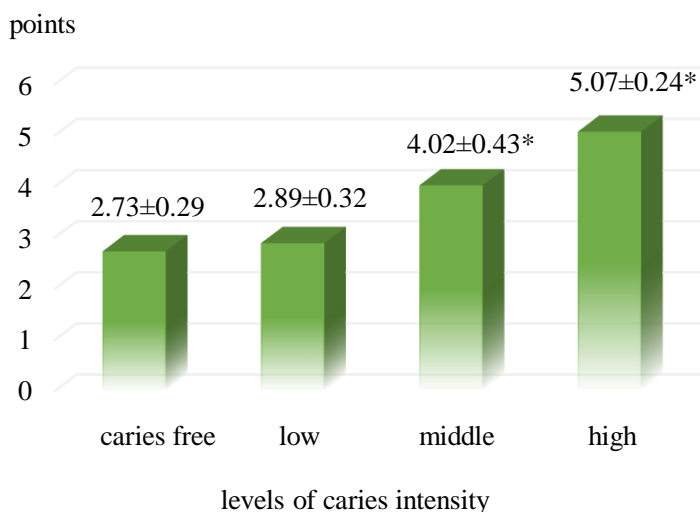


Fig. 2. The results of the TER test in children depending on the intensity level of dental caries.

Note: * – the difference between the indicators of caries free children and children with caries is significant ($p < 0.05$).

Conclusions

Therefore, in children suffering from caries with different levels of caries intensity, a decrease in the level of functional reactions is observed. Changes in the quantitative and qualitative properties of oral fluid, a decrease in the level of salivation, a shift in the active reaction of oral fluid in the direction of increased acidity lead to a violation of the homeostasis of the oral cavity, reducing the level of protective reactions of the oral cavity and deepening the pathological process in the hard tissues of the teeth.

DECLARATIONS:

Disclosure Statement

The author has no potential conflicts of interest to disclosure, including specific financial interests, relationships, and/or affiliations relevant to the subject matter or materials included.

Statement of Ethics

The author has no ethical conflicts to disclosure.

Data Transparency

The data can be requested from the author.

Funding Sources

There are no external sources of funding.

Received: 23 Apr 2023

Accepted: 25 Jun 2023

References

1. Klitynska OV, Stishkovskyy AV, Hasiuk NV. Analysis of the effect of stress level in children 6–7 years of age permanently living in conditions of biogeochemical deficiency of fluorine and iodine on caries incidence rates. Bukovinian Medical Herald. 2020;2(94):46-51. DOI: 10.24061/2413-0737.XXIV.2.94.2020.42 [in Ukrainian].
2. Godovanets OI, Kotelban AV, Grinkevich LG, Romanyuk DG. Factors that cause caries among children. Current state of question. Medicine Today and Tomorrow. 2019;85(4):111-20. DOI: 10.35339/msz.2019.85.04.16 [in Ukrainian].
3. Chukhrai NL, Bezvushko EV, Savchyn SV, Semetsiv KhH, Shpotiuk OO. Features of the course of temporary dental caries in children with Epstein-Barr viral infection. Bukovinian Medical Herald. 2020;3(95):157-64. Available at: <http://e-bmv.bsmu.edu.ua/article/view/2413-0737.XXIV.3.95.2020.87/216790> [in Ukrainian].
4. Lynge Pedersen AM, Belstrom D. The role of natural salivary defences in maintaining a healthy oral microbiota. J Dent. 2019;80:3-12. DOI: 10.1016/j.jdent.2018.08.010. PMID: 30696553.
5. Narepekha O, Lisak T. Structural and functional enamel resistance (TER-test) in children who are studying in boarding school. Ukrainian dental almanac. 2015;6:56-8. Available at: <https://dental-almanac.org/index.php/journal/article/download/95/95/> [in Ukrainian].
6. Oral health surveys basic methods, 5th ed. Geneva: World Health Organization; 2013. 132 p. Available at: https://apps.who.int/iris/bitstream/handle/10665/97035/9789241548649_eng.pdf
7. Kaskova LF, Amosova LI, Kulay OO. Prevention of dental diseases: textbook. Lviv: PP "Magnolia 2006", 2019. 404 p.

Cite in Vancouver style as: Kotelban AV. Physico-chemical properties of the oral fluid and their importance in ensuring dental health. Inter Collegas. 2023;10(1):43-7. <https://doi.org/10.35339/ic.10.1.kot>

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