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Saliva Crystallization Features in Young People with Different Levels of Physical Activity

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Abstract

The aim of the study was to estimate the features of dehydration structuring of saliva in untrained people.

***Methods and Results*:** The study included 35 untrained students and 38 people who regularly exercise, who do not have any chronic diseases. The mean age of participants was 17-18 years. The crystallogenic activity and initiatory potential were evaluated for each sample of biological fluid. The crystallization of mixed saliva was studied using the method of classical crystalloscopy, and the initiating properties were studied by the method of comparative tezigraphy. A 0.9% sodium chloride solution was used as the base substance in the tezigraphic test.

The conducted crystalloscopic studies have demonstrated significant differences in the crystallogenic and initiating properties of mixed saliva in people who regularly engage in physical training, compared with untrained individuals. They manifest themselves in a significant qualitative and quantitative transformation of the crystalloscopic picture of the biological fluid, including single-crystalline and dendritic components, as well as in the representation of amorphous bodies in micro-preparations of the biological medium. In the tezigraphic test, it was found that the initiatory potential of mixed saliva also undergoes significant shifts. These shifts are realized in the activation of the initiating ability of biological fluid and optimization of textural characteristics of tezigrams (reduction of cellular density and increase in uniformity) in combination with a decrease in the degree of destruction of structural picture elements and a moderate expansion of the marginal zone of micro-preparations. (**International Journal of Biomedicine. 2022;12(2):265-268.**)

Key Words: saliva • physical training • metabolism • biocrystallomics

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Introduction

Regular physical training is a common way to increase the adaptive capabilities of the body.[1-5] At the same time, numerous publications are devoted to optimizing the regime and the peculiarities of these training routines,[5-7] while the issue of monitoring the human condition in the dynamics of their use remains controversial.[2,4,7-9] An informative criterion for assessing the functional status of body systems is by testing hemodynamic parameters, including heart rate variability.[4,7,10]

Little attention is paid to the study of the metabolic features of people engaged in physical training.[3,7-9,11] Rather, these studies relate to the biochemical aspects of muscle activity itself.[11,12] In contrast, the effect of regular metered physical activity on metabolic processes in the whole body has not been fully disclosed. In this regard, it is of considerable interest to select and evaluate the capabilities of innovative laboratory diagnostic technologies that allow monitoring the metabolic status of people with constant sports activity.[2,3,11,13] In addition, an important advantage of such methods is to ensure the non-

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invasiveness of the study. In this regard, salivary diagnostics based on the study of parameters of mixed human saliva attracts attention.[9,13-15] It should be noted that this technology can be implemented outside the laboratory/medical facility, which further emphasizes its prospects.

Over the past few decades, the study of crystallogenic properties, including an assessment of their own crystal-forming ability and initiatory potential, has been actively used for the integral analysis of the physicochemical characteristics of biological fluids.[13-16] A similar approach has been used in recent years to study the component composition and physicochemical parameters of mixed human saliva;[9,14,15] however, its capabilities and diagnostic informativeness in sports medicine and adaptive biomedicine have been considered only in isolated publications. In particular, some features of the free crystallogenesis of athletes' saliva were established by us earlier,[8,9] but further research is required to obtain a full understanding of the transformation of the body's biocrystallome in the dynamics of physical training.

The aim of the study was to estimate the features of dehydration structuring of saliva in untrained people.

Materials and Methods

The study included 35 untrained students (Group 1) and 38 people who regularly exercise (Group 2), who do not have any chronic diseases. The mean age of participants was 17-18 years. The exclusion criterion was also the presence of dental pathology in the examined persons. Samples of mixed saliva were obtained from all subjects once by spitting into clean, dry test tubes after twice rinsing the oral cavity with distilled water.

The crystallogenic activity and initiatory potential were evaluated for each sample of biological fluid.[8,9,16] The crystallization of mixed saliva was studied using the method of classical crystalloscopy,[8,9] and the initiating properties were studied by the method of comparative tezigraphy.[16] A 0.9% sodium chloride solution was used as the base substance in the tezigraphic test.

The description of the crystalloscopic picture was carried out morphologically by isolating and calculating the density of individual structural elements of the micro preparation (the average value for three fields of view). All structures were grouped into three main categories: single crystals, polycrystalline (dendritic) elements, and amorphous bodies. Tezigraphic pictures were studied using quantitative (the main tezigraphic coefficient Q, the zonal coefficient P) and semi-quantitative (the severity of cellular density, the uniformity of the distribution of elements, the degree of the picture destruction, and the formation of the marginal zone of the micropreparation) indicators.

Statistical analysis was performed using the Statistica 6.1 software package (StatSoft Inc, USA). A probability value of $P<0.05$ was considered statistically significant.

Results

Evaluation of the results of crystalloscopic and tezigraphic analysis of mixed saliva samples allowed us to establish that in persons who regularly engage in physical training, the physicochemical properties and component composition of the biological fluid vary significantly, relative to untrained people. Thus, according to the crystalloscopic picture of the biosubstrate, qualitative and quantitative rearrangements were found (Table 1). Morphostructural features of the single-crystal picture component of the mixed saliva in Group 2 were a significant decrease in the quantitative representation of elements such as "rectangle" and "prism" against the background of the disappearance of octahedral structures from crystallograms and the appearance of "pyramids" that were absent in Group 1. Concerning the dendritic component of micro-preparations, a significant increase in the density of linear and rectangular polycrystalline elements was recorded in Group 2. At the same time, only representatives of Group 1 reveal figures of the "moss," "onion," and "cross" types, and a distinctive characteristic of the Group 2 representatives is that elements of the "horsetail" type were detected in crystalloscopic pictures.

Table 1.

The crystalloscopic picture of the human saliva, qualitative and quantitative rearrangements in study groups (M±m)

Structure element / Parameter	Untrained students	Trained s tudents
Single crystals		
Rectangle figures	4.0±0.1	2.2±0.1*
Prismatic figures	2.1±0.1	0.6±0.1*
Pyramidal figures	0.9±0.1	–
Octahedral figures	–	1.2±0.1
Dendritic (polycrystal) structures		
Linear dendrites	0.8±0.2	1.9±0.1*
Rectangle dendrites	0.5±0.1	1.2±0.1*
Moss-like and onion-like dendrites	2.7±0.2	–
Cross-like dendrites	0.3±0.1	–
Horsetail-like dendrites	–	6.1±0.2
Rose-like dendrites	–	–
Amorphous bodies		
Size	middle	middle
Number	moderate	many

** – P<0.05 between groups*

In order to determine the direction of the trends identified on the basis of crystalloscopic analysis, the results of the latter were compared with the data of the tezigraphic test (Figures 1-3). It was found that according to the main parameter characterizing the initiatory potential of mixed saliva (the main tezigraphic coefficient Q), the activation of the structuring of the basic substance in the presence of biological fluid was a feature of the training people's tezigrams (Figure 1). In addition, the representatives of this group are

characterized by a significant expansion of the marginal zone of tezigraphic pictures, which led to a significant increase in the zonal coefficient by 1.30 times ($P<0.05$), relative to untrained individuals.

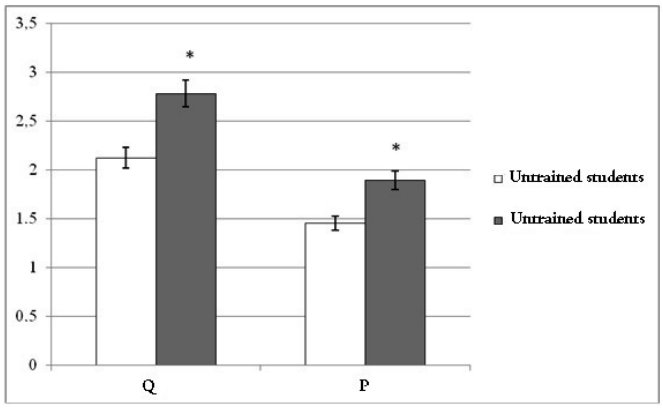

Fig. 1. *The levels of the main tezigraphic coefficient Q and zonal coefficient P in the trained and untrained students (* - P<0.05 between groups)*

The analysis of additional indicators of initiated crystallogenesis–the cellularity and uniformity of the distribution of structural elements in the micropreparation–allowed us to establish that regular physical training contributed to a moderate decrease in the number and size of "crystal islands" in the tezigraphic pictures (Figure 2). Similar changes detected in individuals of this group are clearly correlated with a pronounced increase in the uniformity of texture and spatial distribution of crystalline and amorphous figures in the dehydrated sample, as evidenced by a sharp increase (by 1.75 times, $P<0.01$) in the corresponding indicator R. The resulting integral parameters reflecting the direction of shifts in the initiated crystallogenesis of mixed saliva formed during physical training are the degree of picture destruction and the clarity of the marginal zone of micro-preparations (Figure 3).

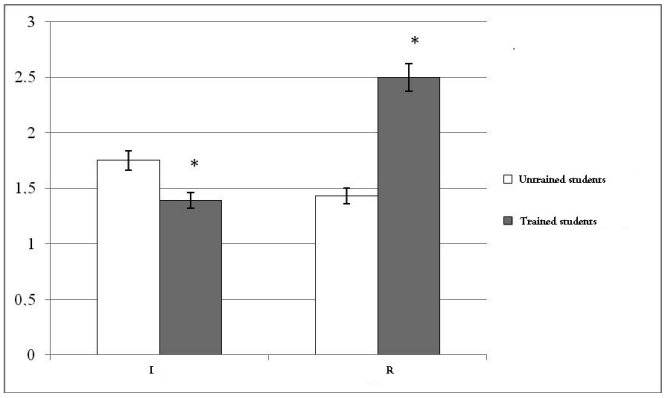

Fig. 2. *The levels of cellularity (I) and uniformity of the distribution of structural elements (R) in the tezigraphic pictures of mixed saliva in the trained and untrained students (* - P<0.05 between groups)*

Similarly, with the indicators of the previous parametric data of tezigraphic pictures, statistically significant differences were observed between the values of trained and untrained people (Figure 3). The degree of picture destruction was markedly reduced in Group 2, (by 1.40 times, $P<0.05$) compared to Group 1, while the clarity of the marginal zone in representatives of Group 2 was revealed at an increased level, compared to Group 1 (by 1.26 times, $P<0.05$). At the same time, taking into account the physicochemical nature of the degree of picture destruction,[8-10] its decrease should be regarded as a positive trend and the effect of regular controlled physical activity on the metabolic status of the subjects' bodies should be positively characterized.

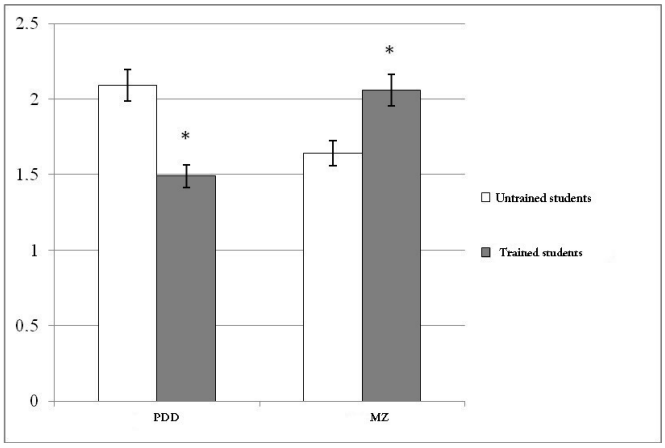

Fig. 3. *The degree of picture destruction (PDD) and the clarity of the marginal zone (MZ) of micro-preparations in the trained and untrained students (* - P<0.05 between groups)*

It is known that the components of the proteome, which have preserved the physiological structure and conformation, are concentrated in the marginal zone of micro-preparations of biological fluids.[8,9,13-16] In this regard, the expansion of the marginal area of tezigraphic pictures observed in Group 2 indicates the optimization of the protein composition of mixed saliva due to regular physical training. Together, the revealed rearrangements of the initiated crystallogenesis of the biological substrate indicate the normalization of its organo-mineral balance.

Conclusion

In general, the conducted crystalloscopic studies have demonstrated significant differences in the crystallogenic and initiating properties of mixed saliva in people who regularly engage in physical training, compared with untrained individuals. They manifest themselves in a significant qualitative and quantitative transformation of the crystalloscopic picture of the biological fluid, including single-crystalline and dendritic components, as well as in the representation of amorphous bodies in micro-preparations of the biological medium. In the tezigraphic test, it was found that the initiatory potential of mixed saliva also undergoes significant shifts. These shifts are realized in the activation of the initiating ability of biological fluid and optimization of textural characteristics of tezigrams (reduction of cellular density and increase in uniformity) in combination with a decrease in the degree of destruction of structural picture

elements and a moderate expansion of the marginal zone of micro-preparations. All of the above suggests that controlled regular physical activity contributes to the normalization of the metabolic status of the body.

Competing Interests

The authors declare that they have no competing interests.

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