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Experimental study of crystallization of biological liquids

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Crystallization of biological fluids - genetically based process associated with the presence of certain organic and inorganic components [*Martusevich*, 2002]. Biological fluids - complex polydisperse non-cellular structures with fragile relationships within them components: saliva, blood serum, lymph, etc. The composition of body fluids are lyotropic liquid crystals, the most minor changes in the body's vital functions are manifested in changes in their structural order. Elements in biological fluids reacts immediately change its structure to any impact of external and internal [*Zakharova et al.,* 2005].

The most simple, yet informative way to assess the physical and chemical properties of biomaterials and biological fluids are in particular crystallographic methods based on qualitative and quantitative description and interpretation crystallization of biosubstrates. They allow you to consider the integrative information content of nutrient liquid. It is important that the crystallization - a process that brings together objects like a living, and the mineral world [*Yushkin et al.,* 1996], in connection with which it may be a universal method for storing and transmitting information. Currently, the crystallographic method of research used to establish the correct diagnosis for different kinds of diseases as a complement to other diagnostic methods. Its essence is to analyze the shapes of crystallization, resulting in drying of various biological fluids [*Selifanova,* 2005].

Oral liquid forms a crystalline structure, as in the native state, and by adding crystal-compounds. The morphology of these structures is due to the chemical composition of saliva [*Belskaya,* 2009]. When you view the resulting crystal structures under low magnification of microscope, it was found [*Denisov,* 2003] that the crystal pattern is uneven and varies in different areas (zones) of dried droplets (Fig. 1).

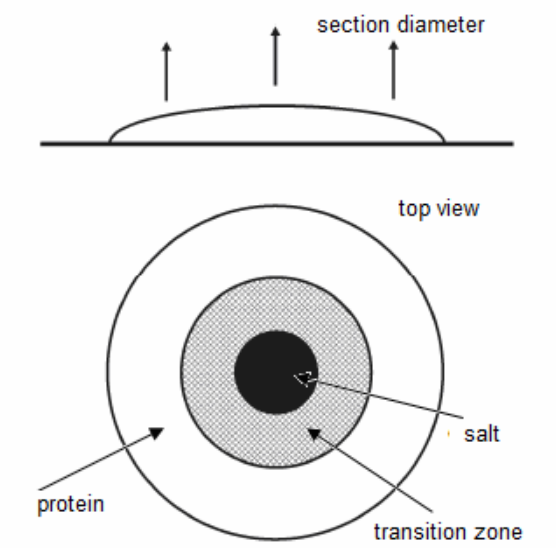

Fig. 1. A drop of body fluid on the plane [*Tarasevich* and *Ayupova*, 2003]

The preparation can distinguish three zones: central zone of crystalline structures, intermediate (zone protein-salt structures) and peripheral (zone of protein structures) [*Tarasevich* and *Ayupova,* 2003]. Most "favorable" growth in the center of the drop: it formed typical dendrite crystals in the

form of a fern, which grows not only on the plane, but also in volume. The site with the structures of ferns can be considered as a zone free of growth. Therefore, assessment of crystalline morphology can only be in the center of crystallization [Barer *et al.*, 2003].

Data type of microcrystallization of saliva (MCS) can be used as a method of assessing the overall condition of the human body. *Objective:* To study the structural features MCS athletes playing sports, to determine the state of sportsmen before and after exercise.

Materials and methods. The experiment involved three groups of sports: volleyball (13), basketball (10), and badminton (18), one age category from 18 to 22 years. Samples of oral fluid were collected three times: before the load after load in the early morning after sleep (off load). Before the fence, the sample surveyed athlete rinsing your mouth with boiled (or distilled) water. Collection of saliva is produced in chemically clean test tubes in an amount of 3–4 ml. Experiment with volleyball players and badminton players was repeated twice with an interval of 1 week. In the process we used the method open the drop [*Belskaya,* 2009], subsequent analysis of obtained images was performed in accordance with the existing scale and criteria for evaluating the type of MCS (Fig. 2).

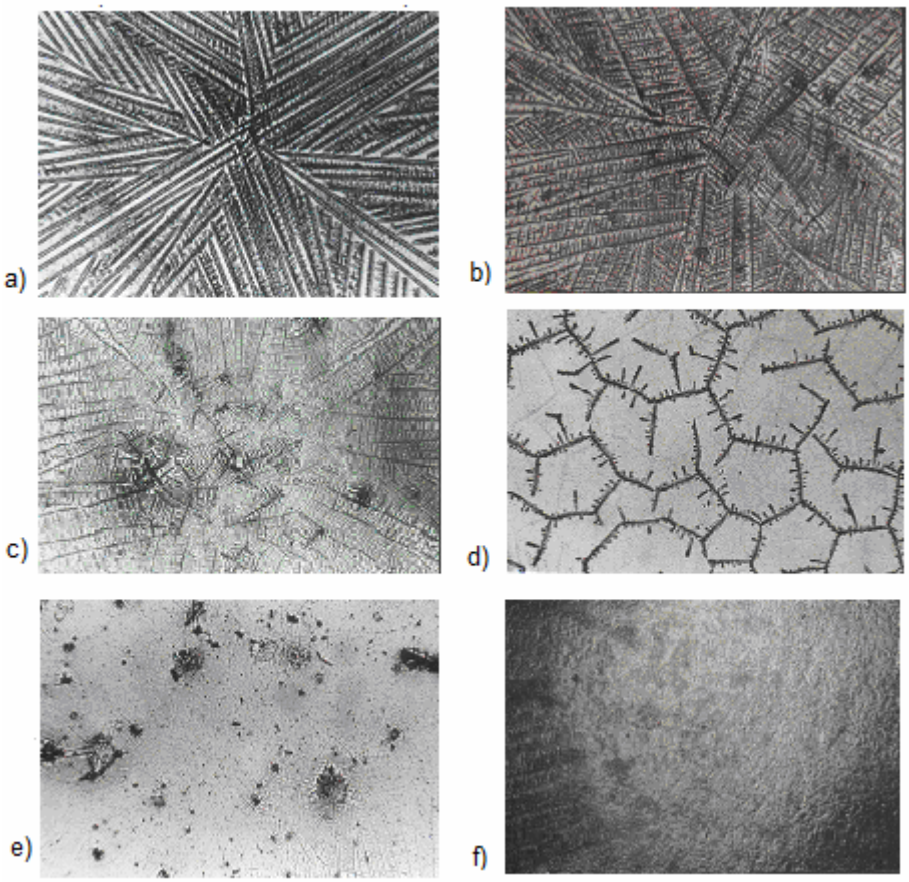

Fig. 2. Types of MCS (a – 5, b - 4, c - 3, d - 2, e - 1, f - 0 points, respectively)

The results of MCS in the "norm" is characterized by a clear pattern of large elongated prismatic crystal structures coming from the center of the drop, fused with each other and having a tree or pteridophytes shape (picture corresponds to 5 points). In assessing the results of MCS when exposed to various adverse factors clearly states the destruction of crystal structure (Fig. 2). Identifies the following types: drawing large prismatic crystal elongated structures, fused together in a random order (4 points) in the center of the drop shows some star-shaped crystals form on the periphery of the enlarged dendrite crystals stored (3 points), the individual crystals in the form of rods or twigs arranged across the field (2 points) over the entire area of the drop a large number of crystal structures is isometrically arranged, stellate, round or irregular shape (1 point); complete absence of crystals in the field of view (0 points).

Mathematical data processing was done using the statistical package STATISTICA 6.0 (StatSoft Inc. USA). Data were analyzed using discriminate and cluster analysis using the statistical package STATGRAPHICS Plus 5.0.

Results and discussion. An analysis of 72 oral fluid samples showed that none of crystals does not correspond to the maximum number of points. Only 4 samples were evaluated at 4 points (5.6%), 29 samples - 3 points (40.3%), 25 samples - 2 points (34.7%), 8 samples - 1 point (11.1%) and 6 samples - on the 0 points (8.3%). Thus, it can be noted that for the studied samples of oral fluid athletes from different sports are most common types of MCS corresponding to 2-3 points, which characterizes the violation of the structural properties of saliva.

In the study of MCS athletes chosen sport revealed a similar pattern. It was found that after training the crystallization of oral fluid as a whole is deteriorating (Table 1).

Table 1. Changing the type of MSC athletes playing sports in the workout.

Sport	Wed point before the load	Wed point after load	Wed point off load
Basketball	3 (61%)	2 (54%)	3 (49%)
Volleyball	3 (50%)	2 (44%)	3 (71%)
Badminton	3 (50%)	2 (60%)	3 (63%)

After loading in most cases, the decay of the crystals of saliva, whereas the recovery occurs after the daily improvement in her MCS. The disintegration of crystals characterized by high levels of stress and tension in the body, thus there is a violation of electrolyte composition of saliva and, above all, changing the Ca/P ratio, which is responsible for the type of the MCS. Improved crystallization shows recovery of the body after exercise (Fig. 3).

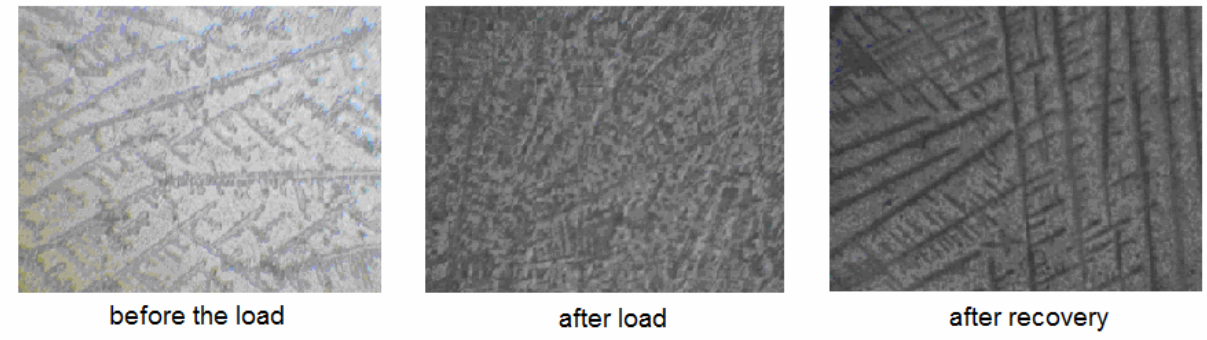

Fig. 3. Change the MCS badminton during exercise

In assessing the shapes of crystallization using the methods of mathematical statistics are also observed significant differences in performance in different periods of training, which was confirmed by discriminate analysis.

It should be noted that when comparing the ISS athletes selected by sports, the best results prior to training were observed in badminton, and after training in volleyball, which in our opinion, may be associated with differences in the training process. But, as noted above, in general, the changes have the same character. Differences between the indices of the two training badminton and volleyball can be explained by different intensity of stress.

Thus, studies have shown that the use of MCS to evaluate the state of the organism and determine the influence of various factors on the homeostasis in the human body.

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