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Biocrystallomics in Dermatology: Aims, Modern State and Perspectives

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Abstract. Data about modern methods of biological substrata crystallization scrutiny is systemized in this article. It is stated, that all technologies are divided into sample preparing methods and modes for scrutiny of biological substrata crystallogenic and initiated properties. Each of these groups is subdivided. These methods classification is proposed on the base of own prolonged investigations and world literature analysis. It is important, that all modus are divided into static and dynamic. This technology has great perspectives in dermatology for several biological systems status estimation by its crystallogenic and initiated properties investigation. It is useful for diagnostics, treatment efficiency estimation and pathogenesis scrutiny of different dermatological diseases.

Keywords: biocrystallomics; biological fluids; dermatosis; diagnostics; pathogenesis.

Introduction. Biocrystallomics is the new synthetic biomedical science, which study human biological substrata crystallization, its physical and chemical essence, functional significance and mechanisms of biogenic crystals formation, presence and degradation in vivo and in vitro [1, 2]. Biocrystallomics fundamental aim is to decode bio-associated crystallization nature and essence in a complex, multidisciplinary way [2].

Main tasks of biocrystallomics are:

1. Biogenic crystals structure and properties study;
2. Qualification of mechanisms and conditions, determination of biocrystallogenesis;
3. Disclosure of bio-associated crystallization functional significance;
4. Investigation of biocrystallization estimation informativeness;
5. Scrutiny of bio-associated crystallogenesis perspectives;
6. Estimation of biological role of biocrystals.

These tasks determinate special selection and classification of informative methods, which can be useful for biocrystallomics biomedical aims.

More than 20 methods of biocrystalloscopic investigations are known [3-10]. These technologies are not systemized now, as it is too difficult for practical use in biological and medical investigations. We divide all biocrystalloscopic methods into two main groups: sample preparing methods and modes for scrutiny of biological substrata crystallogenic and initiated properties (fig. 1).

There are three cohorts of sample preparing methods, differing in specialties of dehydrated biological systems:

1. *crystalloscopic methods*, based on biological objects crystallogenic properties investigation. Existing technologies from this group differ in the character of biocrystals forming conditions. It is shown, that biological fluids crystallization may be accomplished on open glass, quartz or plastic plane and other its modifications, in closed cell, at different temperatures, in vacuum cameras etc.

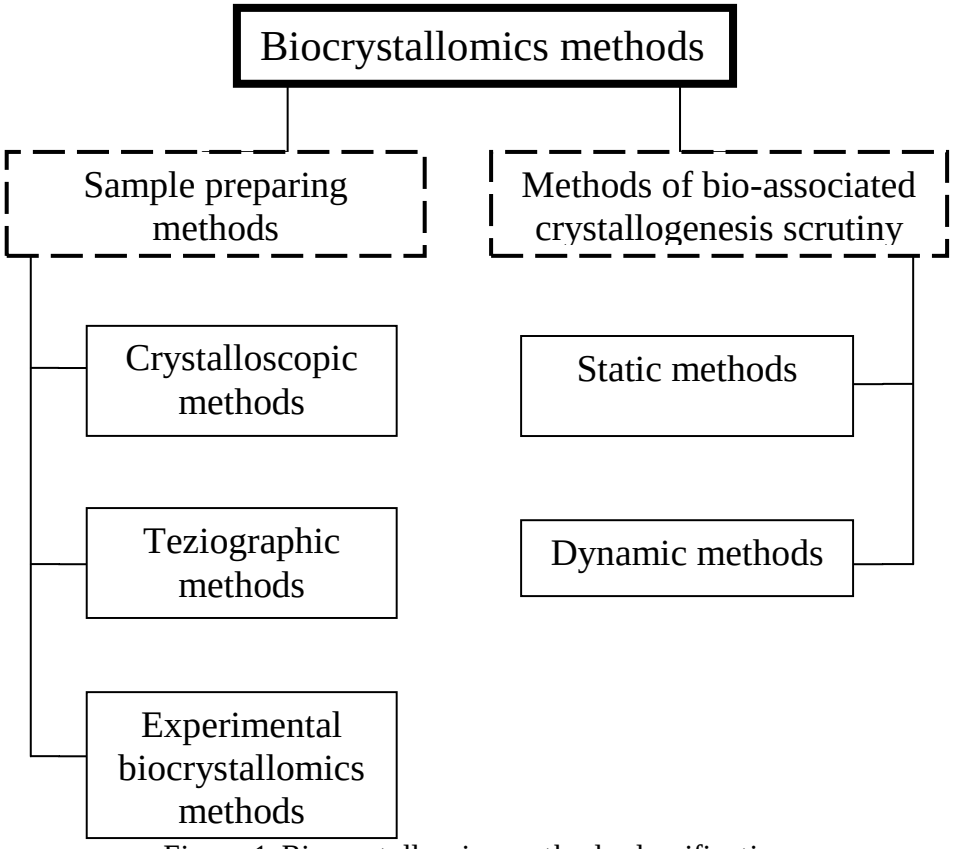
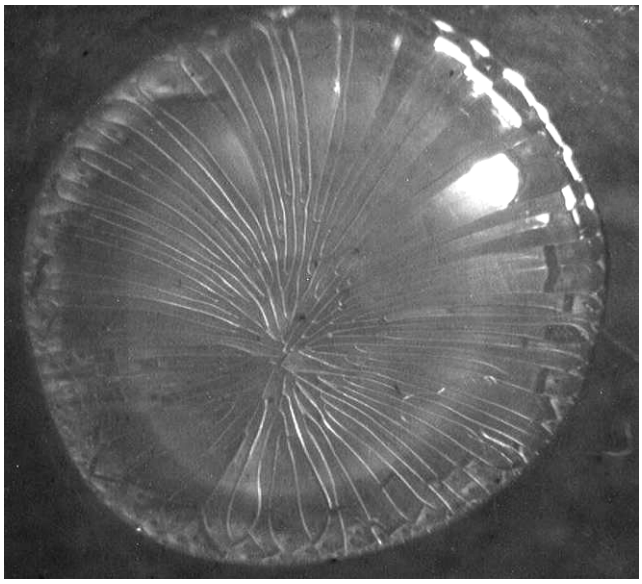


Figure 1. Biocrystallomics methods classification

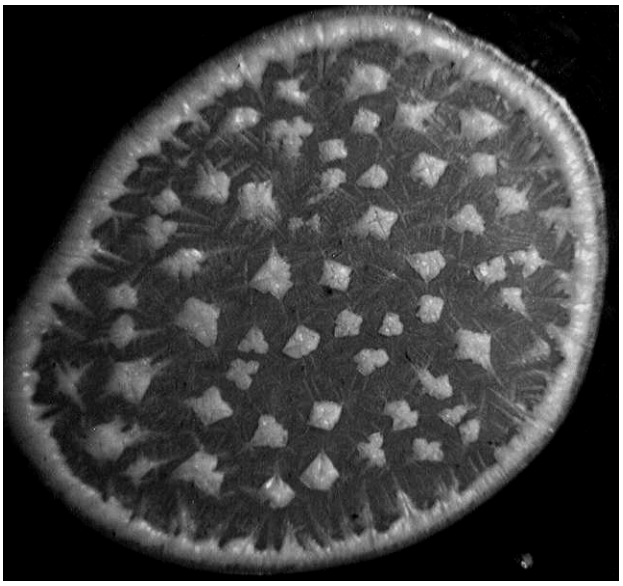
2. *teziographic methods*, allowed to analyze biosubstrata initiating potential. There are three principal variants of teziographic tests. They are classic, comparative and differential teziography. Classis teziography include investigation of co-crystallization of biological substrata and basic substance (high-crystallized or special condition-forming stuff) only. Comparative teziography differ from classic variant in juxtaposition of main (co-crystallization result) and control (only basic substance crystallogenesis) sample. Differential teziography realize comparative variant with several basic substances on one plane.

Examples of blood serum crystalloscopic and teziographic samples are illustrated by figure 2.

Special teziographic technology is chromocrystalloscopy [2]. This method is based on co-crystallization of biological objects with different colored substances. There are three types of chromocrystalloscopy: profile, system and post-dehydrational variant in connection with colored substances addition time.



Crystallogram



Teziogram (basic substance – 0.9% sodium chloride solution)

Figure 2. Example of healthy human blood serum crystalloscopic and teziographic samples.

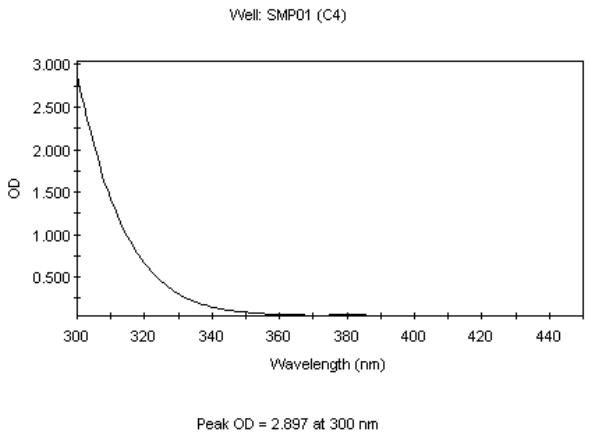
Furthermore, biocrystalloprovoked tests are pertained to this group of methods. This technology includes co-crystallization of biological fluid and metabolite, associated with investigated pathology. It can be useful for prognosing biosystem and macroorganism status dynamics at this pathology progressing.

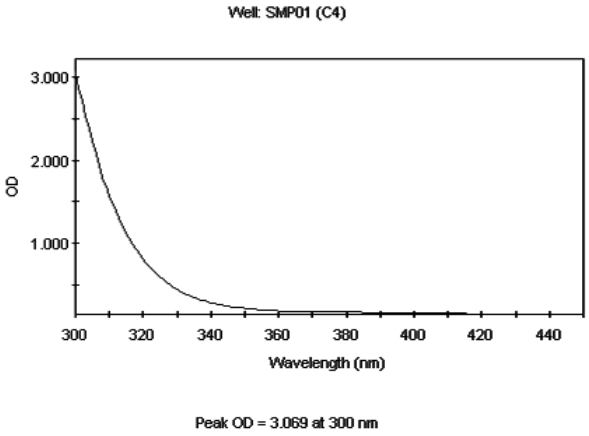
3. *experimental biocrystallomics methods* allow to exclude different manipulations with biological substrata dried drop. There are model composites methods, substrate congregation, liquid crystal thermography etc. This group of methods serves as the basis of biocrystallization direction in vitro and in vivo.

In our opinion, methods of bio-associated crystallogenesis scrutiny can be divided into static (estimation of biological fluids crystal formation *result* – facia) and dynamic (investigation of biosubstrata crystallization *process*).

Main biocrystallomics static methods are facia simple description, its visual morphometry (visuometry), spectrometric investigation of biosubstrata dried samples and facia thermography. Simple description of biological fluids facia includes its microscopic analysis for indicating crystal structures and sample specialties. Visuometry of crystalloscopic and teziographic samples is based on quantitive criteria estimation of facia. These criteria characterize biofluid ability to crystallize and destruct crystals rate. There are structure index, crystallizability, facia destruction degree, protein marginal belt radius for crystalloscopic samples and basic teziographic coefficient, belts coefficient and crystallity for tezigrams. These parameters enable to estimate crystalloscopic and teziographic facias analogically.

For maximal quality of microscopic description and visuometry we recommend use of special morhpmetric complexes, which allow copying crystalloscopic and teziographic puctures from microscope to computer memory.





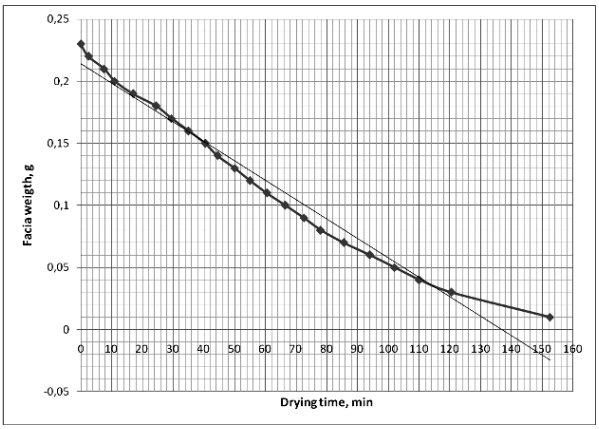
Spectrum of crystalloscopic facia Spectrum of teziographic facia

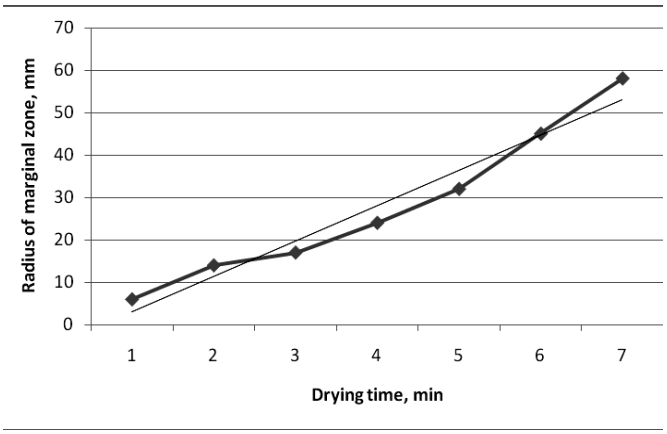
Figure 3. Spectrometry results of crystalloscopic and teziographic specimens of healthy human blood serum

Sample spectrometry is accomplished on spectrophotometers at 300-450 nm wave length [2]. Dehydrated biological fluid optic characteristics are investigated on glass plane. This scrutiny may be a second stage of facia analysis, verifying its visuometry results. Facia optic sett is one of the integral indexes of crystallogram and tezigram estimation, because only spectrogram analysis is not informative (fig. 3) one. Facia optic sett measurement is accomplished with glass optic setts control (crystalloscopic test) or in comparison with basic substance optic set (teziographic test) for errors minimization.

Static variant of facia thermography can be realized by two methods: direct thermometry from plate surface and indirect modus by special teplovisors use, visualizing external facia surface. Last method includes temperature dispersion structure investigation in different crystallogram zones, temperature fields differentiations, central and peripheral temperature gradients accounting etc.

Bio-associated crystallogenesis investigation dynamics technologies are acoustic mechanical impedance (AMI) registration, biogravimetry, proteogravimetry and facia laser flowmetry. Moreover, facia thermography and its visuometry can be accomplished in biological fluid dehydration process dynamics.





Biogravigram Proteogravigram

Figure 4. Bio- and proteogravimetry of healthy human blood serum

Biogravimetry is a biocrystallomics method, based on prolonged estimation of sample mass reduction by high-sensitive libra. Description of biogravimetric result is materialized by the way of each mass unit reduction registration from native biological fluid drop to stabilized facia. Biogravimetry result estimation includes diagram forming in «mass - time» coordinates (fig. 4) and integral biogravimetric coefficient accounting by original algorithms use. Proteogravimetry is

characterized by marginal zone radius dynamics investigation. Scheme of proteogravimetry result analysis turn on analogical diagram forming («radius - time» coordinates) proteogravimetric coefficient accounting (fig. 4).

Drying drop acoustic mechanical impedance (AMI) registration is accomplished on special hardware complex, created by RAS Applied Physics Institute and Aria Analytics (USA) collaboration [11]. Basic principle of this method is biological fluid dehydration estimation on quartz resonator. AMI is a biological object acoustic and mechanical impedance level in oscillating quartz plane [12]. AMI level demonstrate electric conductance rate and is illustrated on computer monitor in real time regimen (AMI line – fig. 5).

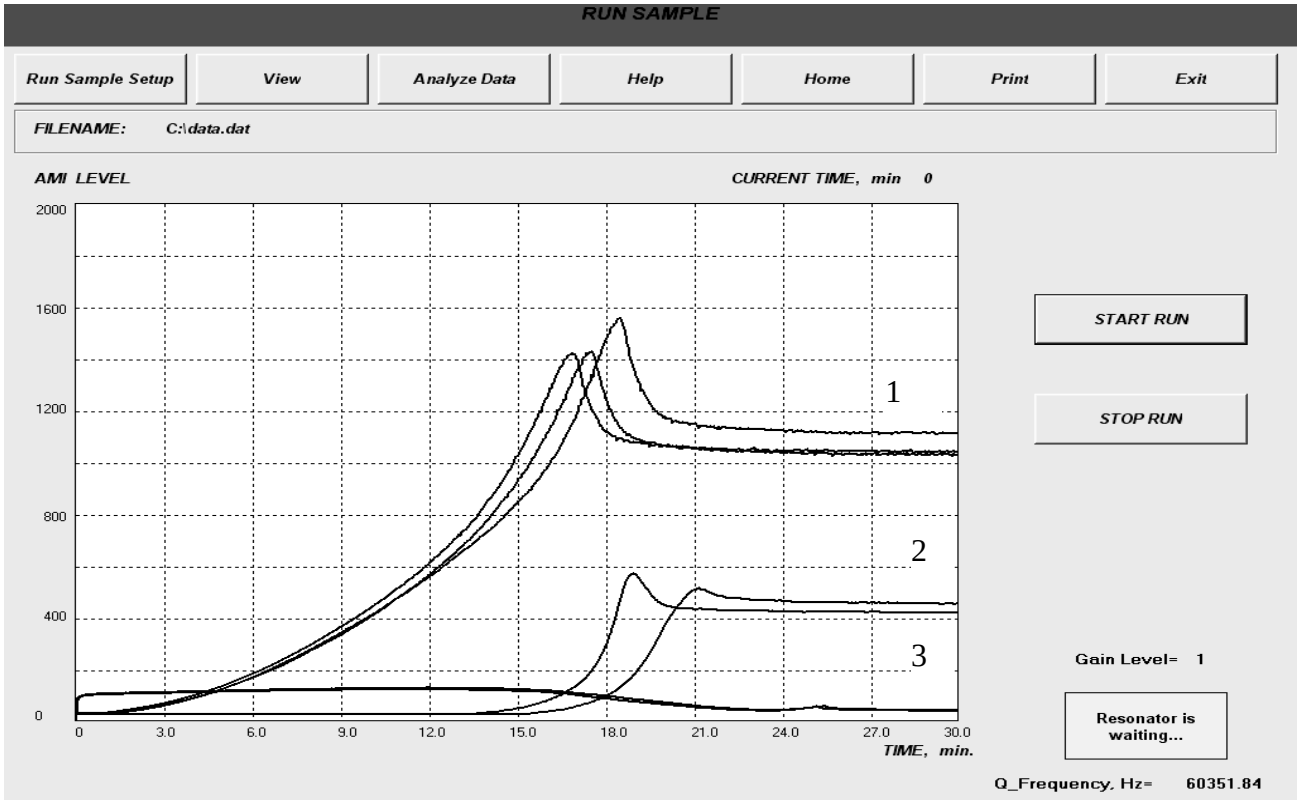


Figure 5. Different biological fluids AMI-lines (1 – blood serum, 2 – urine, 3 - saliva)

Laser flowmetry of crystalloscopic and teziographic samples is the new dynamic method, visualized biomacromolecules moving in drying drop of biological fluids. Further analysis enables to expand spectrum of facias physical characteristics.

Biocrystalloscopic methods in dermatology: results and perspectives

There are few modern scientific publications, concerning use of biocrystalloscopic methods in dermatovenerology. One of the first works, regarding this issue is dissertation of L.V. Potapova (1999), concerned with the transformation of biological substrates crystallogenesis in patients with foot mycosis and occupation-associated vibration disease [13].

Special literature shows some data, concerning diagnostic informativity of own and initiated crystallization of psoriasis blood serum estimation [14] and diffuse diseases of connective tissue [15]. These investigators postulated high diagnostic and differential possibilities of biocrystalloscopic analysis for tested pathology.

N.V. Kungurov et al. (1997) stated that crystalloscopic investigation of biological fluids has diagnostic and prognostic value for urogenital chlamydia [16]. Researchers demonstrated specialties of dehydration structuring pictures («facias»), formed by blood serum, urine and prostatic secret at investigated venerological disease.

Prolonged studies of dehydrated biological fluids solid state (crystalloscopic and teziographic specimens), carried out by Astrakhan specialists, lead to estimation of structural and optic

characteristics of blood serum in patients with leprosy [17]. According to A.A. Yuschenko et al. (2002), it is important for diagnostics of this disease and its treatment efficiency.

Our early researches enable to fix specialties of crystallogenic properties of different biological fluids in dermatological pathology. Particularly, we tested character of crystallogenesis of blood serum and saliva in patients with psoriasis [18], microbial eczema, Duhring disease [19] etc. It was stated, that crystalloscopic and teziographic facias of indicated biological fluids include few small single crystals and amorphic bodies with high signs of destruction processes. Substrate-specific features in these crystallized specimens were partially smoothed out. In our opinion, common mechanisms of described transformations of own and initiated crystallization associated with biological substrata protein component changes and misbalance of pro- and anti-crystallogenic modulators [20]. It is partially confirmed by our model experiments for injection of active oxygen species in blood serum of patients with psoriasis in vitro [21]. In these conditions crystallogenic properties of investigated biological substrata are restorated in part.

As a whole, high diagnostic efficiency, prognostic value and possibilities of management efficiency estimation determined wide perspectives for biocrystallomics methods use in dermatology and venerology. In addition, these technologies can be used for investigation of dermatoses pathogenesis.

Conclusion. Finally, modern biocrystallomics has many different methods, helping to estimate biological substrata crystallogenic and initiate potential complexly. This technology has great perspectives for several biological systems status estimation by its crystallogenic and initiated properties investigation. It is useful for different diagnostic, prognostic and treatment monitoring tasks of experimental and clinical dermatology and venerology.

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Биокристалломика в дерматологии: цели, современное состояние и перспективы

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Аннотация. В данной статье систематизированы сведения о современных методах изучения кристаллизации биологических субстратов. Показано, что они подразделяются на технологии подготовки образцов и непосредственного анализа кристаллогенных и инициирующих свойств биожидкостей, причем каждая из указанных групп содержит дополнительные подгруппы. Приведенная классификация методов базируется на результатах собственных многолетних исследований и анализе мировой литературы. Кроме того, методы биокристалломики могут быть динамическими и статическими. Показано, что технологии кристаллоскопического исследования биосубстратов имеют широкие перспективы в дерматологии в плане оценки характеристик различного биоматериала для задач диагностики, оценки эффективности лечения и изучения особенностей патогенеза заболеваний дерматологического профиля.

Ключевые слова: биокристалломика; биологические жидкости; дерматозы; диагностика; патогенез.