Fiber sensors for noninvasive physical stress monitoring

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The physical stress causes biochemical, molecular, and genetic changes associated with the adaptation reactions to physiological stress. Secretion of saliva and its composition are controlled by the autonomic nervous system (ANS), with the change in ANS activity leads to a change in the characteristics of saliva secretion [1]. The relationship between the functional state of the human body and physiological activity of the salivary glands suggests the possibility of using the saliva as the source of diagnostic information, which possesses a number of advantages over analysis of other biological fluids [2, 3].

Nowadays the panel of methods used in saliva analysis broad performed by immunoassay, colorimetric, enzymatic, kinetic, chromatographic and mass spectrometric methods. Identification and quantification saliva biochemical parameters in the middle infrared region are not used for diagnostic purposes, although its components are highly specific bands in this spectral region [4].

We focused our work on noninvasive physical stress monitoring using saliva as a diagnostic biomaterial and fiber sensors as an analysis technique. The study included 48 well-trained regularly practicing male athletes. Saliva samples were collected before and immediately after treadmill test with an incremental step protocol until exhaustion.

Saliva spectra were recorded in the 4000–700 cm^{-1} region using FTIR spectrometer ReactIR 1000 coupled with PIR-fiber probe. The volume of saliva sample was 2 μL. The sample was dried on the probe tip 3-5 min and then the spectra of saliva film were recorded. Analysis was done by calculation of difference spectra (rest saliva spectrum subtracted to exercise saliva spectrum). IR-difference spectra clearly show the influence of physical stress. Cluster analysis of spectral date showed the best sportsmen saliva spectrums were quite different from others.

Vibrational spectroscopy of saliva plus real time monitoring and molecular analysis can be done by PIR-fiber probes. The problem of noninvasive methods of determination training status and metabolic changes during endurance exercise is essential. The present study has demonstrated that new way including surgery FTIR spectrometry with fiber optic probes is useful tool for determination metabolic changes in saliva and the real-time checking of response to stress.

Acknowledgements

References
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